Smithsonian Institution

VOL. VI. MAY, 1882. NO. 1.

THE KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY.

EDITED BY

THEO. S. CASE.

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A MONTHLY RECORD OF PROGRESS IN

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Edited and Published by THEO. S. CASE,

KANSAS CITY, MISSOURI.

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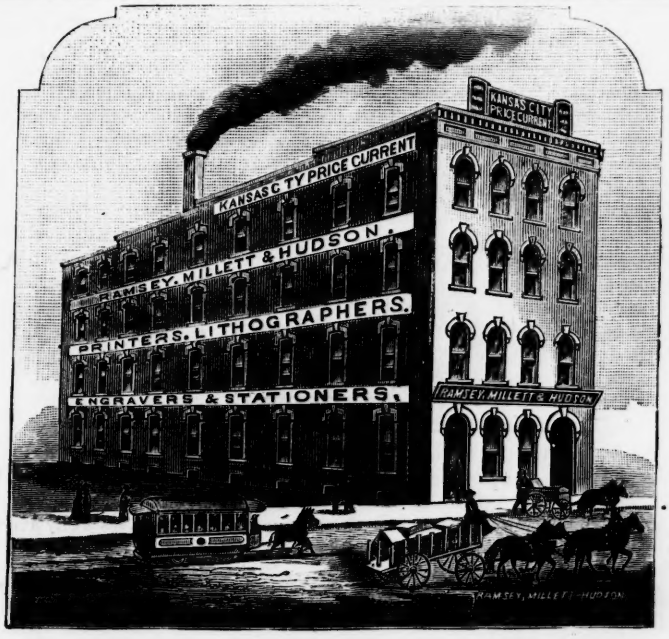

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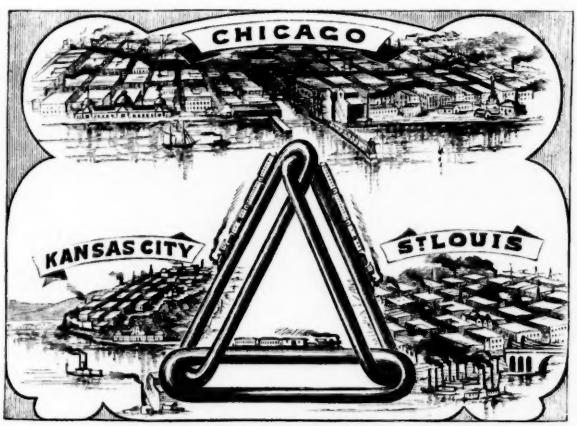

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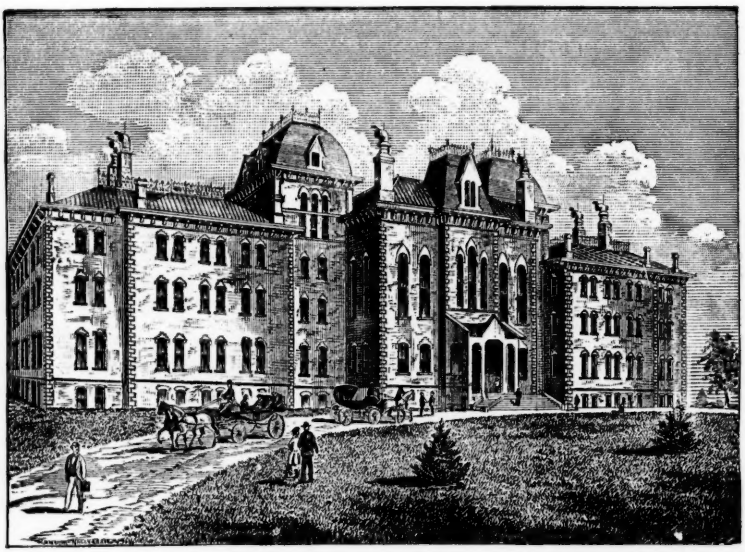

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REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. VI. MAY, 1882. NO. 1.

METEOROLOGY.

METEOROLOGICAL SUB-CONDITIONS.

BY C. A. SHAW, MADISON, WIS.

It seems to be more and more apparent that meteorology belongs to that order of experimental science which depends upon a calculation of contingencies. It resembles medical practice in the fact that for every individual case the treatment must be modified. General principles exist, are to be known, but the empirical practitioner is sometimes more successful in the cure of special diseases. It is hardly possible that in the future it can be safely said: "Two years from date such an epidemic will prevail and such a treatment of all attacked must be resorted to." Even if the first statement was acceded to the second would not be received without opposition. In fact, the difference between a scientific practitioner and the reverse is that the first is not so certain of fixed remedies. He accepts once for all the dictum that "circumstance alter cases," and that "good sense is something that all science needs to make any remedy successful."

In meteorology what is known bears a very small ratio to what is unknown, and the final "why is it," is still less definite than the general term "it may be expected." Even in civil engineering, field-practice modifies a good many theories of the school-room, and the text-book is found lamentably deficient in those details called *practical*, which are the frequent obsticles that inexperience

stumbles over in attempting to use astronomical formulas where a rule-of-thumb fits so nicely.

That water runs down hill, that winds blow because mechanical pressure makes them, that clouds change from local conditions, these seem trifling axioms to the too-far-come-seeking meteorologists of some reports, official and otherwise, and yet it can hardly be doubted that the final causes of many atmospheric phenomena are by no means very remote and recondite, but on the contrary near at hand, and having similitudes in *everyday* and trifling experiences.

There is really wanted a well-edited meteorological journal—exclusively meteorological—for every special science needs a special treatment. The habits of mind of all classes of specialists take a peculiar tone from their occupation. As in art, landscape and genera artists agree as to general principles, but differ wldely in their methods of handling and treatment of subject, as in music instrumentalists and vocalists are each bound to special qualities of excellence, so in science, meteorologists cannot move quite easily with naturalists, botanists, archæologists, though there is really more sympathy than divergence between them.

However that may be, the study of meteorology seems now to be, as at first stated, a calculation of contingencies. The atmosphere seems to be a particularly unstable medium. It is exceptionally in extremes, now of heat and cold, now of greater or less pressure, and now of moisture or of dryness. Because it is of one nature to-day we may expect the opposite soon. When the barmometer is high it presages the coming of that which is termed a low. If the track of an area of small pressure is exceptionally out of its normal course it seems to take more time for nature to get back to her established routine, and meanwhile extravagance is the order of her motions.

All this is rather that of a philosophy which deals in chances than with exact science. Is it not possible that for a few years this will have to content us? although we have something fairly certain to go upon. For example, the following is a table of tracks of low barometers during March, from the point of view of a resident of Madison, Wisconsin.

If we were to put in brief form a general statement of weather conditions, it would be something in this form, taking the above table as a text or reference sheet. Taking for example,

GENERAL CONDITIONS OF STORM AREAS.

A difficult problem in modern meteorological science is the discovery of a reason for the variation of these almost periodic low barometer tracks. That there are normal directions corresponding to the several seasons of the year, is certain, and also that there are divergencies frequent enough to be expected, though when and where still eludes accurate formulating. If it be true, as those who favor the mechanical or theory of vortices believe, that there is a permanent northwesterly current north of us and a permanent south and southeast current south to southeast of us, and that their meeting and conflict, now to the partial advantage of the one and now to the partial advantage of the other, produces

A COMPARATIVE TABLE OF LOW BAROMETER AREAS DURING MARCH, 1882.

DATE.	4th	8th	11th	14th	17th	20th	23d	25th	28th ....
General Direction of Wind Preceeding Low Barometer.	NE	NE	SW	SW	SE	N	NW	NW	NW
Barometer Reading before Storm.	30.37	30.35	30.17	30.25	30.25	30.12	30.38	30 40	29.95
Average Velocity of Wind before Storm	10	12	15	10	10	10	14	16	20
General Direction of Wind during Fall of Barometer.	E	E	W	SE	E	E	W	SE	S
Maximum Velocity of Wind during Fall.	32	20	28	21	25	28	18	15	28
Total Wind during Fall. (24 hours).	519	300	172	274	449	418	283	326	458
Lowest Barometer Reading.	29 68	29.74	29.86	29.90	29.68	29 53	30.08	29.39	29.55
Average Fall per hour. (Gradient).	.05	.03	.02	.02	.04	.05	.01	.03	.03
Total Rain-fall during Fall of Barometer.	.58	.34	.06	.28	.15	.74	0	.40	0
General Direction of Wind after Storm.	SW	NW	N	NW	W	NW	N	W	W
Maximum Velocity of Wind during Rise of Barometer.	25	34	24	14	25	32	30	25	28
Total Wind during 24 hours Rise.	385	449	387	218	270	503	400	415	514
Barometer Reading after Storm.	30.10	30.20	30.17	30.25	30.10	30.30	30.40	29.95	30.40
Average Rise. (Gradient per hour).	.03	.03	.02	.02	.03	.05	.02	.02	.05
Total Rain-fall during Rise of Barometer.	0	.45	0	.02	.35	.07	0	1.39	0
Direction from which Storm Approached.	SW	SW	W	NW	W	SW	W	W	NW
Passed Madison to the North, South, or Centrally.	S	S	N	C	S	C	N	N	N
Direction after Passing.	N of E	NE	E	SE	E	N of E	E	E	E

In effect, this is nearly the same as the following table, which possibly the editor will omit.

WEATHER REPORT—LOCAL SUMMARY FOR MARCH, 1882.

SIGNAL SERVICE U. S. A., MADISON, APRIL 1.

MARCH, 1882.	Mean Daily Barometer.	Mean Daily Thermometer.	Prevailing Direction of Wind.	Barometer—Rising or Falling.	Highest Temperature.	Lowest Temperature.	Rainfall—inches.	Maximum Hourly Velocity of Wind.	Total Number of Miles in 24 hours.
1	29.779	47.7	W	29.70	62	37	. . .	18	213
2	30.110	45 3	NW	R	61	37	. . .	20	175
3	30.318	40.3	NE	30.37	50	34	. . .	13	188
4	29 937	38.3	E	29.68	43	33	.58	33	519
5	29 827	35.7	SW	R	43	32	. . .	25	385
6	30 218	25.3	W	. . .	32	23	——	22	356
7	30.620	22.0	NE	30.65	29	15	——	17	249
8	30.357	30.0	E	F	36	23	.13	13	211
9	29.903	26.7	N	29.75	30	25	.66	34	484
10	30.270	29.7	NW	30.30	35	25	——	16	257
11	30.160	29.3	SW	F	33	26	.05	12	181
12	29.935	26.7	W	29.87	33	22	.01	24	301
13	30.162	25.7	NW	R	34	17	——	18	278
14	30 129	32.3	SE	F	39	27	.25	21	274
15	30.052	34.7	N	R	37	32	.05	16	218
16	30.302	35.7	E	30.36	40	31	——	20	184
17	29.911	36.7	E	F	38	34	.32	25	449
18	29.870	39 0	NW	29.67	49	35	.08	22	270
19	30.174	39.0	N	30.25	48	30	——	12	158
20	29.734	38.7	E	F	43	35	.74	28	418
21	29.722	24 3	W	29.56	39	19	.07	32	503
22	30.328	29.7	NW	30.38	39	22	——	25	372
23	30.200	34.0	NW	F R	49	22	. . .	30	445
24	30 401	23.7	N	High	35	14	. . .	24	276
25	29.916	36.0	SE	F	43	31	.35	25	326
26	29.586	39.7	N	29.39	49	35	.95	12	118
27	29.761	36.7	NW	R	43	33	.49	25	415
28	29.832	43.7	S	F	50	32	. . .	28	372
29	29.793	45.0	W	R	58	36	. . .	28	514
30	30.431	32.3	NW	30.48	41	27	. . .	25	307
31	30.213	43.3	S	F	57	31	. . .	. . .	. . .
S'm	. . .	.	. . .	. . .	. . .	. . .	4.73	. . .	9732
M'n	30.063	34.4	NW	. . .	42 5	28 2	. . .	21	314

these cyclonic nuclei which express themselves as storm centers; or whether it be that there are, perhaps, stationary heapings of atmosphere along certain latitudes which push shoulder to shoulder, like two athletes, and mutually struggle to encroach and prevent encroachment; or whether local influences, varia-

tions in the distribution of heat, either of territorial action, or from equinoctial shiftings or other suppositions, none can be applied with a dominant purpose of practical utility.

Of the immediate effect, however, of the passage of one of these areas of lower pressures the conditions follow very regularly. As the depression approaches from the west or southwest, the wind begins to blow from the southeast to east, increasing in force as the greatest gradient is reached. If the area passes south of a station, the wind follows it round from the northeast to north and northwest. If it passes to the north of the station, the wind takes a reverse direction from the southeast to south and southwest, the velocity of the following wind being dependent upon similar differences of pressure as that which acted during its approach.

The rainfall, it is to be noticed, depends rather upon local conditions, as the greater or less humidity which the winds possess from passing over areas of snow or bodies of water. It frequently happens that a wind partially saturated receives sufficient additional moisture to produce precipitation over a damp district, which would be inoperative over a dry one.

The normal action of an area of low barometers seems to depend upon its free passage in the line of its natural direction. If this course is interrupted, as by the opposition of a body of air of greater pressure, so that its movement is delayed or wholly arrested, the tendency is to narrow its dimensions, sometimes to turn it aside, and generally to increase its destructive cyclonic tendencies, while not infrequently a second area is developed at some distance to the south, which moves obliquely to join it. The contrary effect of a dissipation of a marked area results when opposition to its movements becomes removed. Its force is then expended in a lateral expansion.

Perhaps this dissipation is the result of a secondary formation, which causes a transference of direction of pressure, for if we look at the line of a track of low barometer we cannot fail to be struck by its valley-like line. It is as if it were the track of a marble among shifting elevations of an agitated soil.

Whatever electrical influences may accompany the passage of a storm area their accessory nature seems quite well proven. Their intensity is certainly associated with peculiar conditions of the atmosphere rather than with variations in its pressure, as indicated by the barometer, and if it can be shown that the mechanical action of the winds is the chief element of these disturbances there will be renewed the extraneous and conflicting theories which now distant the gathered facts and prevent accurate formulating of simple mechanical causes for their results.

WEATHER REPORT FOR APRIL, 1882.

FROM OBSERVATIONS TAKEN AT LAWRENCE, KANSAS, BY PROF. F. H. SNOW, OF THE STATE UNIVERSITY.

During this month the temperature and cloudiness were above the average, while the rainfall and wind velocity were nearly normal. The cold week, from 9th to 16th, produced only harmless "white frost," so that the immense fruit crops have escaped entirely uninjured. There was a brilliant auroral display on the night of the 16th, and a curious storm of almost impalpable dust on the 18th from 5 to 5:30 p. m.

Mean Temperature—56.83°, which is 3.02° above the average April temperature of the fourteen preceding years. The highest temperature was 88°, on the 1st and 21st; the lowest was 35°, on the 11th; monthly range, 53°. Mean at 7 a. m., 52.23°; at 2 p. m., 65.38°; at 9 p. m., 54.88°.

Rainfall—3.20 inches, which is 0.17 inches above the April average. Rain fell on nine days. There was no snow. There were five thunder showers, of which four were accompanied by hail. The entire rainfall for the four months of 1882 now completed, has been 7.18 inches, which is 0.62 inch below the average for the same period in the fourteen preceding years.

Mean Cloudiness—51.77 per cent of the sky, the month being 3.06 per cent cloudier than the average. Number of clear days, 12, (entirely clear, 4); half clear, 6; cloudy, 12, (entirely cloudy, 6). Mean cloudiness at 7 a. m., 57.33 per cent; at 2 p. m., 55.33 per cent; at 9 p. m., 42.66 per cent.

Wind—Southwest, 21 times; southeast, 17 times; northeast, 15 times; south, 9 times; north, 9 times; northwest, 8 times; west, 6 times; east, 5 times. The entire distance travelled by the wind was 14,226 miles, which gives a mean daily velocity of 474.20 miles, and a mean hourly velocity of 19.76 miles. The highest velocity was 40 miles an hour, from 2 to 4 p. m. on the 17th.

Mean Height of Barometer—29.032 inches; at 7 a. m., 29.065 inches; at 2 p. m., 29.006 inches; at 9 p. m., 29.027 inches; maximum, 29.449 inches, on the 29th; minimum, 28.542 inches, on the 21st; monthly range, 0.907 inches.

Relative Humidity—Mean for month, 61.7; at 7 a. m., 69.8; at 2 p. m., 48.7; at 9 p. m., 66.8; greatest, 100, on the 22d; least, 21.3, on the 30th. There was no fog during the month.

The following table furnishes a comparison with preceding Aprils :

APRIL.	Mean Temperature.	Maximum Temperature.	Minimum Temperature.	Rain, Inches.	Mean Cloudiness.	Miles Wind.	Mean Humidity.
1868	49.65	83.0	25.0	2.95	52.00	. . .	. . .
1869	51.44	87.0	18.0	2.43	51.00	. . .	72.1
1870	56.84	91.0	19.0	1.08	49.33	. . .	54.7
1871	57.90	92.0	30.5	2.38	47.11	. . .	53.5
1872	56.42	85.0	30.0	4.74	55.12	. . .	56.5
1873	48.85	88.0	26.0	4.42	55.89	18.371	63.4
1874	48.77	83.0	22.5	2.86	51.11	14.784	57.7
1875	49.70	82.0	23.0	2.54	48.22	14.144	57.6
1876	55.60	87.5	30.0	3.38	44.78	14.442	59.6
1877	53.90	81.0	25.0	3.13	53.00	11.976	64.9
1878	58.60	82.0	36.0	5.48	38.22	11.482	66.0
1879	56.40	84.0	20.0	4.18	49.67	11.231	61.0
1880	56.92	93.0	31.0	1.75	34.56	16.709	53.4
1881	52.47	84.0	13.0	1.27	51.78	14.495	67.6
1882	56.83	88.0	35.0	3.20	51.77	14.226	61.7
Mean of 15 Aprils.	54.01	86.0	25.5	3.04	48.91	14.184	60.7

PRECIPITATION AND AVERAGE TEMPERATURE FOR MARCH, FOR EIGHT YEARS AT MORRISON, ILLINOIS.

S. A. MAXWELL, VOL. OBS. U. S. SIG. SERV.

YEAR.	PRECIPITATION.	TEMPERATURE.
1875	1.00 Inches.	29.09°
1876	8.09 "	31.58
1877	5.19 "	26.70
1878	1.85 "	48.05
1879	2.40 "	39.57
1880	2.37 "	36.37
1881	2.85 "	28.88
1882	3.25 "	37.37
MEANS	3.37 Inches.	34.70°

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

Highest barometer during month 29.29, on the 30th. Lowest barometer during month 28.56, on the 20th.

Highest temperature during month 87°, on the 2nd. Lowest temperature during month 4°, on the 12th.

Highest velocity of wind during month 60 miles, on the 25th.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	ar. 20th to Apr. 1st.	Apr. 1st to 10th.	Apr. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	29.0	49.4	33.5	37.3
Max	62.0	75.5	52.3	63.3
Min. and Max	45.5	62.4	43.0	50.3
Range	34.0	26.1	19.1	26.4
TRI-DAILY OBSERVATIONS.				
7 a. m.	39.9	57.6	43.4	47.0
2 p. m.	61.1	69.9	55.3	62.1
9 p. m.	47.0	59.0	47.4	51.1
Mean	49.0	60.6	48.3	55.9
RELATIVE HUMIDITY.				
7. a. m.	.78	.78	.72	.76
2 p. m.	.43	.58	.61	.54
9 p. m.	.60	.76	.77	.71
Mean	.60	.70	.70	.67
PRESSURE AS OBSERVED.				
7 a. m.	29.01	28.87	28.96	28.95
2 p. m.	28.99	28.86	28.91	28.92
9 p. m.	28.99	28.86	28.89	28.91
Mean	29.00	28.86	28.92	28.93
MILES PER HOUR OF WIND.				
7 a. m.	19.0	15.9	14.1	16.3
2 p. m.	28.7	26.2	19.1	24.7
9 p. m.	21.3	15.6	15.0	17.4
Total miles	6616	5035	4099	15750
CLOUDING BY TENTHS.				
7 a. m.	3.4	5.6	5.2	4.7
2 p. m.	3.1	5.9	6.2	5.1
9 p. m.	1.7	5.0	4.9	3.9
RAIN.				
Inches	.00	2.30	.58	2.88

THE ARRIVAL OF MAN IN EUROPE.

BY JOHN FISKE.

Toward the close of the Pleistocene age, the general outlines of the European continent had assumed very much their present appearance everywhere except in the northwest. The British Islands still remained joined to one another and to the Gaulish mainland, and occupied the greater part of the area of the German Ocean. According to Mr. James Geikie, the connection with Norway again became complete, and the Atlantic ridge was again so far elevated as to bring Scotland into connection with Greenland through the Faroe Islands and Iceland. The whole of Britain stood at an average elevation of from 600 to 1000 feet above its present level. The Thames, Humber, Tyne, and Forth, must all have flowed into the Rhine, which emptied itself into the North Sea beyond the latitude of the Shetlands. The glaciers of Europe had retreated within the Arctic Circle, or up to the higher valleys of the great mountain ranges; and the climate was beginning to assume its present temperate and equable character.

At this remote epoch Europe had already been inhabited by human beings during several thousand years. How long before the beginning of the Pleistocene period man had arrived in Europe is still open to question; but there is no doubt whatever that he lived in Gaul and Britain as a contemporary of the big-nosed rhinocerous, and before the arrival of the Arctic mammalia which were driven from the north as the glacial cold set in. This race of man—described by Mr. Boyd Dawkins as the "River-Drift-Man"—is probably now as extinct as the cave-bear or the mammoth. Late in the Pleistocene period it disappeared from Europe, and was replaced by a new race, coming from the northeast, along with the musk-sheep and reindeer, and called by the same eminent writer the "Cave-Man." Both the Cave-Men and the Red-Drift men were in the stage of culture known as the Palæolithic, or Old Stone Age; that is, they used only stone implements, and these implements were never polished or ground to a fine edge, but were only roughly chipped into shape, and were very rude and irregular in contour. The Palæolithic Age, referring as the phrase does to a stage of culture, and not to any chronological period, is something which has come and gone at very different dates in different parts of the world. It may be convenient to remember that in northwestern Europe it seems to have very nearly coincided with the Pleistocene period, provided we also bear in mind that the coincidence is purely fortuitous.

The implements of the River-drift men, found in Pleistocene river-beds, are very rude, and imply a social condition at least as low as that of the Australian savages of the present day. "They consist," says Mr. Dawkins, "of the flake; the chopper or pebble roughly chipped to an edge on one side; the *hâche* or oval-pointed implement, intended for use without a handle; an oval or rounded form

with a cutting edge all round, which may have been used in a handle; a scraper for preparing skins; and pointed flints used for boring." Man did not then seek for the materials out of which to make these weapons or tools, but "merely fashioned the stones which happened to be within his reach—flint, quartzite, or chert—in the shallows of the rivers, as they were wanted, throwing them away after they had been used." No pottery of any sort has been found in association with these implements, nor were there at that period any domesticated animals. The River-drift men were evidently no tillers of the ground, neither were they herdsmen or shepherds; but they gained a precarious subsistence by hunting the great elk and other deer, and contended with packs of hyænas for the caves which might serve for shelter against the storm. As to what may have been the social organization of these primeval savages, nothing whatever is known. They were a wide-spread race. Their implements have been found, in more or less abundance, in Britain, Germany, France, Spain, Italy, Greece, Northern Africa, Palestine, and Hindustan. Their bones have been found in the valleys of the Rhine, the Seine, the Somme, and the Vezère, in sufficient numbers to show that they were dolicocephalic or long-headed race, with prominent jaws, but no complete skeleton has as yet been discovered.

These River-drift men, as already observed, belonged to the southern fauna which inhabited Europe before the approach of the glacial cold. As the climate of Europe became arctic and temperate by turns, the River-drift men appear to have by turns retreated southward to Italy and Africa, and advanced northward into Britain, along with the leopards, hyænas, and elephants, with which they were contemporary. But after several such migrations they returned no more, but instead of them we find plentiful traces of the Cave men,—a race apparently more limited in its range, and clearly belonging to a sub-arctic fauna. The bones and implements of the Cave-men are found in association with remains of the reindeer and bison, the arctic fox, the mammoth, and the woolly rhinoceros. They are found in great abundance in southern and central England, in Belgium, Germany, and Switzerland, and in every part of France; but nowhere as yet have their remains been discovered south of the Alps and Pyrenees. A diligent exploration of the Pleistocene caves of England and France, during the past twenty years, has thrown some light upon their mode of life. Not a trace of pottery has been found anywhere associated with their remains, so that it is quite clear that the Cave-men did not make earthenware vessels. Burnt clay is a peculiarly indestructible material, and where it has once been in existence it is sure to leave plentiful traces of itself. Meat was baked in the caves by contact with hot stones, or roasted before the blazing fire. Fire may have been obtained by friction between two pieces of wood, or between bits of flint and iron pyrites.

Clothes were made of the furs of bisons, reindeer, bears, and other animals, rudely sewn together with threads of reindeer sinew. Even long fur gloves were used, and necklaces of shells and of bear's and lion's teeth. The stone tools and weapons were far finer in appearance than those of the River-drift men, though they were still chipped, and not ground. They made borers and saws as well as

spears and arrow-heads; and besides these stone implements they used spears and arrows headed with bone, and daggers of reindeer antler. The reindeer, which thus supplied them with clothes and weapons, was also slain for food; and, besides, they slew whales and seals on the coast of the Bay of Biscay, and in the rivers they speared salmon, trout, and pike. They also appear to have eaten, as well as to have been eaten by, the cave-lion and cave-bear. Many details of their life are preserved to us through their extraordinary taste for engraving and carving. Sketches of reindeer, mammoths, horses, cave-bears, pike and seals, and hunting scenes have been found by the hundred, incised upon antlers or bones, or sometimes upon stone; and the artistic skill which they show is really astonishing. Most savages can make rude drawings of objects in which they feel a familiar interest, but such drawings are usually excessively grotesque, like a child's attempt to depict a man as a sort of figure eight, with four straight lines standing forth from lower half to represent the arms and legs. But the Cave-men, with a piece of sharp-pointed flint, would engrave, on a reindeer antler, an outline of a urus so accurately that it can be clearly distinguished from an ox or a bison. And their drawings are remarkable not only for their accuracy, but often equally so for the taste and vigor with which the subject is treated.

Among uncivilized races of men now living, there are none which possess this remarkable artistic talent save the Eskimos; and in this respect there is complete similarity between the Eskimos and the Cave-men. But this is by no means the only point of agreement between the Eskimos and the Cave-men. Between the sets of tools and weapons used by the one and by the other the agreement is also complete. The stone spears and arrow-heads, the sewing-needles and skin-scrapers, used by the Eskimos are exactly like the similar implements found in the Pleistocene caves of France and England. The necklaces and amulets of cut teeth and the daggers made from antler, show an equally close correspondence. The resemblances are not merely general, but extend so far into details that if modern Eskimo remains were to be put into European caves they would be indistinguishable in appearance from the remains of the Cave-men which are now found there. Now, when these facts are taken in connection with the facts that the Cave-men were an arctic race, and especially that the musk-sheep, which accompanied the advance of the Cave-men into Europe, is now found only in the country of the Eskimos, though its fossil remains are scattered in abundance all along a line stretching from the Pyrenees through Germany, Russia, and Siberia,—when these facts are taken in connection, the opinion of Mr. Dawkins, that the Cave-men were actually identical with the Eskimos, seems highly plausible. Nothing can be more probable than that, in early or middle Pleistocene times, the Eskimos lived all about the Arctic Circle, in Siberia and northern Europe as well as in North America; that during the coldest portion of the Glacial period they found their way as far south as the Pyrenees, along with the rest of the sub-arctic mammalian fauna to which they belonged; and that, as the climate grew warmer again, and vigorous enemies from the south began to press into Europe and compete with them, they gradually fell back to the north-

ward, leaving behind them the innumerable relics of their former presence, which we find in the late Pleistocene caves of France and England. The Eskimos, then, are probably the sole survivors of the Cave-men of the Pleistocene period: among the present people of Europe the Cave men have left no representatives whatever.

With the passing away of Pleistocene times, further considerable changes occurred in the geography of Europe and its population. Early in the Recent period the British Islands had become detached from each other and from the continent, and the North Sea and the English and Irish Channels had assumed very nearly their present sizes and shapes. The contour of the Mediterranean, also, had become nearly what it is now; and in general such changes as have occurred in the physical structure of Europe during the Recent period have been comparatively slight. Of the mammalia living at the beginning of this period, only one species, the Irish elk, has become extinct. The gigantic Cave-bear, the cave-lion, the mammoth, and the woolly rhinoceros had all become extinct at the close of the Pleistocene period, and the elephants and hyænas had finally retreated into Africa. In Europe were now to be found the brown and grizzly bears, the elk and reindeer, the wild boar, the urus or wild ox, the wolf and fox, the rabbit and hare, and the badger; and along with these there came those harbingers of the dawn of civilization,—the dog and horse, the domestic ox and pig, with the sheep and goat. A new race of men, also, the tamers and owners of these domestic animals, had appeared on the scene. These new men could build rude huts of oak logs and rough planks, made by splitting the tree trunks with wedges. Such work was not done with chipped flint-flakes. The men of the early Recent period had the grindstone, and used it to put a fine edge on their stone hatchets and adzes; so that their appearance marks the beginning of a new era in culture. The sharp and accurate edge of the axe, unattainable save by grinding, is the symbol of this new era, which is known to archæologists as the Neolithic, or New Stone Age.

The huts of the Neolithic farmers and shepherds were built in clusters, and defended by stockades. Wheat and flax were raised, and linen garments were added to those of fur. The distaff and loom, in rude shape, were in use, and grain was pounded in the mortar with a pestle. Rude earthenware vessels were made, sometimes ornamented with patterns. Canoes were also in use. The dead were buried in long barrows, and from the almost constant presence of arrow-heads, pottery, or trinkets in these tombs it has been inferred that the Neolithic men had some idea of a future life, and buried these objects for the use of the departed spirits, as is the custom among most savage races at the present time

The celebrated lake-villages of Switzerland belong to the Neolithic or early Recent period; and the remains of their cattle and of their cultivated seeds and fruits have thrown light upon the origin of the Neolithic civilization. It is certain that the domestic animals did not originate in Europe, but were domesticated in Central Asia, which was the home of their wild ancestors; and, moreover,

they were not introduced into Europe gradually and one by one, but suddenly and *en masse*. It is clear, therefore, that they must have been brought in from Asia by the Neolithic men; and the same is true of the four kinds of wheat, two of barley, the millet, peas, poppies, apples, pears, plums, and flax, which grew in the gardens and orchards of Neolithic Switzerland.

This rudimentary Neolithic civilization was spread all over Europe, with the exception of the northern parts of Russia and Scandinavia; and there can be no doubt that it lasted for a great many centuries. It certainly lingered in Gaul and Britain long after the valley of the Nile had become the seat of a mighty empire; perhaps even after the Akkadian power had established itself at the mouth the of Euphrates, and "Ur of the Chaldees" had become a name famous in the world. Still more, it is clear that the Neolithic population has never been swept out of Europe, like the Cave-men and the River-drift men who had preceded it, but has remained there, in a certain sense, to this day, and constitutes a very important portion of our ancestry.

So many skeletons have been obtained of the men and women of the Neolithic period that we can say, with some confidence, that the whole of Europe was inhabited by one homogeneous population, uniform in physical appearance. The stature was small, averaging 5 feet 4 inches for the men, and 4 feet 11 inches for the women; and the figure was slight. The skulls were "dolicocephalic," or long and narrow; but the jaws were small, the eyebrows and cheek-bones were not very prominent, the nose was aquiline, and the general outline of the face oval and probably handsome. In all these points the men of the Neolithic age agree exactly with the Basks of northern Spain, the remnant of a population which at the dawn of history still maintained an independent existence in many parts of Europe. By their conquerors, the Kelts, who led the van of the great Aryan invasion of Europe, these small-statured Basks were known as "Iberians" or "westerners" (Gael *iver*, Sanskr. *avara*, "western"), and "Iberian" is now generally adopted as the name of the race which possessed the whole of Europe in the Neolithic age and until the Aryan invasions, and which still preserves its integrity in the little territory between the Pyrenees and the Bay of Biscay. The Iberian complexion is a dark olive, with black eyes and black hair; so that we may figure to ourselves with some completeness how the prehistoric inhabitants of Europe looked.

It is probable that in Neolithic times this Iberian population was spread not only all over Europe, but also over Africa north of the Desert of Sahara; so that the Moorish and Berber peoples are simply Iberians, with more or less infusion of blood from the Arabs, who conquered them at the end of the seventh century after Christ. And it is also probable that the Silures of ancient Britain, the Ligurians of southern Gaul and northern Italy, and the rich and powerful Etruskans all belonged to the Iberian race.

In very recent times—probably not more than twenty centuries before Christ—Europe was invaded by a new race of men, coming from central Asia. These were the Aryans, a race tall and massive in stature (the men averaging at least 5

feet 8 inches, and the women 5 feet 3 inches), with "brachycephalic" or round and broad skulls, with powerful jaws and prominent eyebrows, with faces rather square or angular than oval, with fair, ruddy complexions and blue eyes, and red or flaxen hair. Of these, the earliest that came may perhaps have been the Latin tribes, with the Dorians and Ionians; but the first that made their way through western Europe to the shores of the Atlantic were the Gael, or true Kelts. After these came the Kymry; then the Teutons; and finally—in very recent times, near the beginning of the Christian era—the Slavs. These Aryan invaders were further advanced in civilization that the Iberians, who had so long inhabited Europe. They understood the arts which the latter understood, and besides all this, they had learned how to work metals; and their invasion of Europe marks the beginning of what archæologists call the Bronze Age, when tools and weapons were no longer made of polished stones, but were wrought from an alloy of copper and tin. The great Blonde Ayrans everywhere overcame the small brunette Iberians, but, instead of one race exterminating or expelling the other, the two races everywhere became commingled in various proportions. In Greece, southern Italy, Spain, and southern France, where the Iberians were most numerous as compared with the Aryan invaders, the people are still mainly small in stature and dark in complexion. In Russia and Scandinavia, where there were few Iberians, the people show the purity of their Aryan descent in their fair complexion and large stature. While in northern Italy and northern France, in Germany and the British Islands, in Iberian and Aryan statures and complexions are intermingled in endless variety. * * * —*Atlantic Monthly.*

ASTRONOMY.

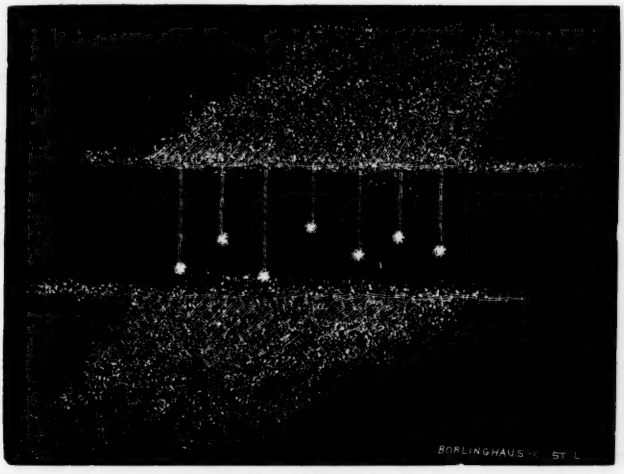
AURORAL PHENOMENA ON THE EVENING OF SEPT. 12, 1881.

BY E. A. ENGLER, WASHINGTON UNIVERSITY, ST. LOUIS.

As an addition to data from which a more complete knowledge of certain celestial phenomena now unexplained may in future be derived, it may not be out of place to record a description of a peculiar and interesting phenomenon seen by the writer and others at sea off the coast of Newfoundland.

On September 12th, 1881, after a nine days' voyage on the Atlantic from London towards Halifax, N. S., Cape Race was sighted about noon. Our course after noon was about southwest; at eight o'clock in the evening (ship's time) our position—estimated roughly by the course and speed of the ship—was Lat. 46° N., Long. 55° W. The sky was partly clear in the north and west and overhead, but hazy and in places cloudy in the south and east. The aurora was

clearly to be seen in the northern sky, sometimes shooting up streamers of light nearly to the zenith, and varying continually in form and brightness; this display, however, was no more brilliant or interesting than many similar ones seen on other nights, and deserves mention only to be distinguished from the following. But in the southeast sky, about 30 or 35 degrees above the horizon, there appeared two horizontal streaks of light—about five 5 degrees apart and 15 or 20 degrees in length—which at the time I took to be two clouds highly charged with electricity. The accompanying sketch (Fig. 1) will be of service in describing the appearance, but must not be taken as accurate in any detail, being made after some months and from memory; moreover, the entire phenomenon was continually changing. Both streaks were luminous, with a pale hazy light very similar to moonlight. From the upper of the two were suspended by small cords of light a number of balls, brighter than either of the streaks, which were continually jumping up and down in vertical lines, much after the manner of pith-balls when charged with electricity. Above the upper streak there was a bright space, whose sides were convergent at about the angle shown in the sketch, which seemed to be composed of streamers of light, gauzy in appearance and decreasing in brightness from the streak outwards. From the lower streak a similar mass of light extended. The only difference noticed in the two streams of light was that the inclination of the lower was greater than that of the upper.



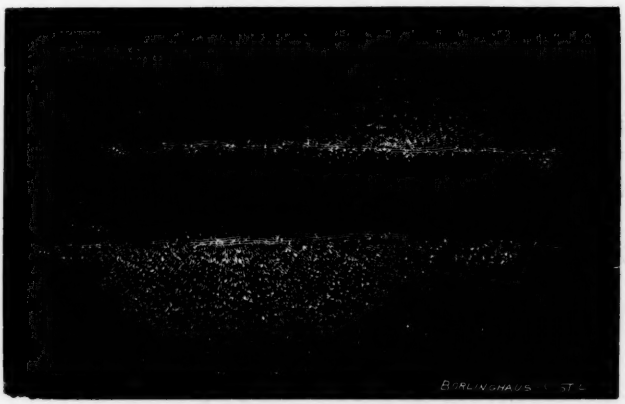
(FIG. NO. 1.)

I appeared on the scene about fifteen or twenty minutes after the beginning when the brilliancy of the display was approaching a maximum. Soon after it began to fade, the balls and cords first gradually disappearing, then the streamers of light on both sides, and finally the two horizontal streaks—the whole being lost to sight in the darkness in the course of about fifteen minutes.

When first seen the phenomenon had the appearance shown in the sketch (Fig. 2.), kindly furnished me by Prof. Halsey C. Ives, who had the good fortune to see the display at the beginning, but lost the latter part of it. The sketch gives an idea of what he saw only in general form. He says that it did not seem to him that there were clouds, but rather a space between clouds through which light was streaming; the upper luminous appearance seemed to him to be an inverted reflection of the lower one. The position remained unchanged during the whole time.

No explanation of the phenomenon is offered.

The matter may have a wider interest when it is remembered that on the evening of September 12th, at the fame hour, a most remarkable band of white light was seen at Albany, N. Y., Utica, N. Y., Hanover, N. H., Boston, Mass., and elsewhere in the North Atlantic States, spanning the heavens from east to west near the zenith. The following account of the phenomenon seen at Albany, given by an assistant at the Observatory, is taken from the Albany *Argus:*



(FIG. NO. 2.)

"At eight o'clock I first saw it, and its effect was absolutely startling. It spanned the heavens from east to west, and seemeed of very nearly equal breadth the whole distance. It was sharply defined. At its southern edge it extended from the horizon through Zeta and Delta Bootis; thence through Nu Pi Hercules, to and through Alpha Lyra. From that point it extended to the south of the Great Square in Pegasus. The northern branch in the east extended up through the head of Draco, and there seemed to be a strong ray of light, very marked, continuing from Gamma Bootis, while around to the north there were several parallel streaks inclined at an angle of fifty degrees with the general motion of the phenomenon. Three or four of these were noticed near the head of Draco. At 8:30 it was observed to clear away on the zenith. The eastern portion now consisted of a narrow strip, very bright, clearly marked at the edges, extending from Gamma Pisces through Alpha Lyra, and at the same time seeming to be

moving southwest, it being about thirty degrees from he zenith and appearing to roll like columns of smoke spirally towards the west. At 8:33, in the east were two parallel streaks, the northern the heavier and the southern throwing out diverging lines of light that seemed to gradually curve as they approached the zenith. At 8:35 o'clock the main branches had separated at the zenith, while the western one was very narrow, extending through the Northern crown. A small line of light now extended from a point about three degrees north of Alpha Lyra to a point about seven degrees from Eta Ursa Major. At 8:39 a brighter streak appeared between Alpha Lyra and Ursa Major, while that over the Crown was broken up into a series of parallel, smaller and fainter streaks. The eastern branch was now very faint and narrow, and extended nearly from Pi Pisces to Alpha Lyra, while all along the northern horizon was a bright rosy glow like the Northern Lights, but brightest toward the west. At 8:45 the phenomenon presented a faint, yet beautiful appearance, and 8:55 it had vanished."

In the Kansas City REVIEW OF SCIENCE AND INDUSTRY, November, 1881, Prof. S. A. Maxwell, Morrison, Ills., remarks:

"The mysterious band of light seen at Albany was probably, what I have stated, a mere auroral arch, but, appearing as it did in the zenith, more nearly resembled a band than an arch. The same viewed from a lower latitude would have presented an arch-like appearance, similar to those often seen by us in the distant north; and these latter would present to an observer beneath them the same band-like appearance seen at Albany."

My point of observation was north and east of any I have seen mentioned; some other explanation is needed for the appearance there presented.—*Transactions St. Louis Academy of Science.*

COINCIDENCE OF SUN SPOTS AND AURORAL DISPLAYS.

PROF. EDGAR L. LARKIN.

Sunday, April 16th, will pass into the history of astronomy as an eventful day. From morning to night the solar surface was in violent agitation, while colossal centers of cyclonic activity were clearly seen in telescope. There were 111 spots seen during the day, the largest being 67,000 miles in length and 48,000 miles in width. These were arranged in ten clusters, none being far from the equator of the sun. Thirty-four spots was the largest number seen in any cluster. Each aggregation of spots had one or two very large, the remainder varying in size from medium to small. The large spot was seen at this Observatory at 8 A. M. April 15, already advanced on the eastern edge of the sun 15 degrees. Throughout the 15th it did not display unusual turbulence, but during Saturday night activity set in, for on Sunday morning its appearance and internal structure had materially changed. It was cut into four portions by what was

termed "bridges" of fire. But these bridges did not maintain the same position an hour. They were widening, contracting, or bending into ever-changing forms. They were white hot; that is, whiter than the solar disc,—presumably hotter. One could not see them move any more than the hour-hand of a clock can be seen in motion, but on returning to the telescope after an interval of half an hour, displacement could be detected. At 9 A. M. two tongues of fire were pointing toward each other from opposite sides of the abyss, and at 12:30 P. M. P. M. passed, leaving quite a space between. Shortly after they began a curvature, which, at 2 P. M., formed a circle, clearly a case of solar cyclone.

A sun-spot is composed of two portions, the umbra and penumbra. The umbra is the dark central portion, while the penumbra or border is many shades lighter, yet, much darker than the disc of the sun. The penumbral fringe looks like a down-rush of matter into or upon the umbra; its sides are inclined, and are striated throughout, the striæ having the appearance of willow leaves laid on the incline, parallel to one another, their small ends projecting over the back umbra, giving the edge of the penumbra a serrated form, like saw-teeth. When many of these projections join and receive an impulse, they pass entirely across the umbra, forming an incandescent bridge. And Sunday every large spot had bridges complete or in the process of formation. In the large chasm, at about 4:30 in the afternoon, one of the bridges split lengthwise, the separation requiring more than two hours, while the ends of several jets were tufted and tasseled with filaments of white hot matter, which coinciding near the center of one of the largest divisions, presented the appearance of the whirlpool rapids below Niagara, should that frenzy of water be instantly rendered motionless. We have no spectroscope, but with one of good dispersion we should have been able without doubt to behold movement in the troubled mass; or, at all events, the displacement of hydrogen lines in the spectrum of the seething vortex. Neither have we a micrometer; hence were not able to arrive at accurate measurement. But the results above, 67,000 miles in length and 48,000 miles in breadth, are within 2,000 miles of the truth. The width given is that at the maximum point; the spot, contracting somewhat toward the solar equator, gives it the shape of a rude triangle. Calculating its area, we found that thirty worlds like the earth, side by side, could plunge at once into the mighty gulf and be destroyed in a moment. Measurement was made by time of transit of longest diameter of spot over central wire in eye-piece, the time being ten seconds. But one second of time of the earth's rotation equals fifteen seconds of arc, celestial space. One second of space on the sun is 450 miles, and the diameter of the spot being 15,000 seconds arc, made 67,500 miles. Several spots beside had diameters of from 5,000 to 10,000 miles, which, forming centers of clusters, gave the solar disc an impressive aspect. There were three faculæ also on the sun—brilliant spaces much brighter than the general surface. The terrestrial atmosphere being in fine condition for telescopic manipulation, the "rice-grains," granulations and pores all over the sun could be distinctly seen. Altogether the day was one of moment in the means offered of studying solar

phenomena, and we shall be impatient until Prof. C. A. Young makes a report of his observations with the diffraction spectroscope, scarcely daring to think even of a possibility of clouds hanging over Princeton, N. J. We watched the sun the entire day, and when it disappeared in the west, wished the day might be longer, but night brought still other wonders in the heavens.

At 9 P. M., while viewing Wells' comet, it waned and disappeared. Looking out to learn the cause, its obscuration was found to come from the rising arc of an aurora. The advancing phenomenon presented a yellowish-green arc of a circle, whose altitude was eighteen degrees--nearly half way to Polaris—and whose ends rested on the eastern and western horizon. The thickness of the light was five degrees, clear sky showing the stars in Cassiopeia, being between it and the horizon. The center of the auroral arc did not appear to be on a line below the pole star, so we proceeded to measure its displacement with the declination circle on the telescopic axis. The eastern termination of the arc was only fifteen degrees north of the equator, while the western was twenty-five degrees, the center, therefore, being ten degrees east of the pole of the heavens. For nearly an hour the apparition developed no sign of coming grandeur, but at 10 P. M., three pillars of crimson light shot up to an altitude of forty degrees from the western extremity of the arc, a few yellowish streamers ascending in the east. These outbursts seemed to be a preconcerted signal with the celestial pyrotechnists, for within two minutes the whole arch flashed and trembled, and then expanded, ascending eight degrees. A halt was made, which lasted, however, not more than one minute, when two flashes in rapid succession were seen throughout the widened arc now twenty degrees broad. A mighty upheaval followed, the apex of the band at once rose to Polaris, filling the northern heavens with supernal light brilliant enough to read by; but the terminal points on the horizon, east and west, did not draw nearer the earth's equator. The altitude of the pole at this place is forty-one degrees, and as there was open sky under the band ten degrees wide the belt was thirty degrees broad. The great aurora reserved its forces a few moments and then discharged simultaneously hundreds of columns of scarlet, violet, and light yellow flames, instantly converging at the zenith.

This display waned only to make way for another more magnificent; and so the whole night passed, outbursts succeeding in rapid movement. From midnight to 1 A. M. the phenomena was at its heighth, the whole northern heavens from the horizon to the equator being striped and banded with varying streamers. Flashes were incessant. A wave of light would appear in the northern horizon, and instantly rush to the zenith, producing curvature in the straight columns, which at once resumed their original position when the wave subsided, only to be wrought again within a few seconds. The whole northern hemisphere quaked with the rapidity of lightning without cessation during the hour succeeding midnight, each outburst of energy impelled light-emitting matter directly to the zenith, when it was no longer subject to upheaval, but floated slowly south. Much of this actually descended as far as Scorpio, thirty degrees south of the equator, so

that nearly the entire celestial vault was filled with corruscation. This unparalled display of auroral activity was still in motion at 4:30 A. M., when the solar rays obscured the scene. The sun-spot maximum occurs at periods of eleven years, and we are now in the midst of one of these ; but it is now known that auroral displays and secular disturbance of the earth's currents of magnetic energy, as indicated by diurnal oscillation in declination of the needle, also have eleven years as their periodic time of maximum, and behold both epochs are coincident with the maximum solar period of upheaval. When the sun's surface is in agitation we have auroras and large vibration in the magnetograph following terrestrial magnetic storms.

A remarkable solar phenomenon occurred on the sun Sept. 1, 1869, and was seen by two observers at the Kew Observatory in England. Two jets of the most brilliant light burst from the solar surface just preceeding a large spot. These remained in view five minutes and moved 33,700 miles. The time of the occurrence was noted, and then the self registering magnetographs were examined, and, to the astronomer's surprise, were found to have been in great agitation at the precise time of the outburst, showing that magnetic force, whatever it may be, does not require time to traverse the distance of the sun, while light consumes eight minutes in the journey. In sixteen hours the earth suffered a magnetic disturbance, telegraph offices were set on fire, and an aurora was seen in the evening. [See Chambers' Astronomy, pp. 22–3.] These facts show that there exists a magnetic relation between the sun and earth, whose nature cannot be surmised, and auroral displays are doubtless electric or magnetic; yet this branch of science is so barren of facts that an opinion, even, on these topics cannot be formed.

The perpetual flashing of the aurora, Sunday night, was its most noteworthy feature, and seemed to clearly indicate its electric character. Polariscopic research into the nature of the light might be of service, while it is to be hoped spectra of the last display were closely examined. Study was made of auroral phenomena during the last maximum, 1870–3, but spectroscopes of such power were not then in use as may now be obtained. Anybody with a smoked glass can now see the great spot on the sun with no other optical aid. It will be well to deposit the carbon film on the glass with varying degrees of thickness. The solar turbulence, the aurora, and Well's comet are making lively astronomical times

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THE AURORA OF APRIL 16, 1882.

NOTES AND OBSERVATIONS BY A. W. BROWNE, OF THE U. S. SIGNAL SERVICE, LEAVENWORTH, KANSAS.

The Aurora Polaris is a luminous appearance frequently seen near the horizon as a diffuse light like the morning twilight, whence the title "aurora." In this hemisphere it is usually termed "Aurora Borealis," on account of being seen

chiefly in the north. Its congener when seen in the southern hemisphere, is called "Aurora Australis;" both may be more pertinently classed "aurora polaris," or polar light.

At 9 o'clock Sunday night a horizontal light, similar to the morning aurora or break of day, was observed along the northern horizon; gradually but steadily it extended in length and height, and after a lapse of fifteen minutes several vertical, luminous beams of a pale yellowish tint, and extending to from 30 to 40 degrees above the horizon, appeared, thus presenting unmistakable evidence of the appearance within our visual range of that beautiful and sublime phenomenon, the "Aurora Polaris." A 9:20 these beams vanished, and were immediately followed by several faint arches appearing simultaneously and parallel; they were arcs of small circles, our meridian bisecting the uppermost one at a point 30 degrees above the horizon. Beams similar to but more numerous than the primary ones shot up from these arches, while a dark segment obscured that portion of the heavens nearest the horizon, and continued throughout the successive recurrences. A more decidedly active phase of the display developed at 10 P. M., when a column of a rosy hue shot up from the horizon, at a point west of north, and quickly deepened to almost a blood red; as if by preconcertion a series of similar columns appeared in rapid succession to the right of it. They were of less width, but of greater altitude, some reaching to as high as eighty degrees above the visible horizon, and extending from north to nearly due east. This first began to wane at 10:20, and fifteen minutes later only a faint trace of the display could be seen. Traces of diminished activity continued until shortly after midnight, when an almost identical recurrence of the last active display took place. Details are therefore unnecessary. It was, however, of greater extent, as the space along the horizon from 45 degrees west of north to due east, or in all 135 degrees of the celestial vault was almost simultaneously covered with auroral light, many of the columns going as high as the "Zenith." This spectacle lasted about twenty minutes, and then the usual faint trace of diminished activity ensued until 3:10 Monday A. M., when a reaction took place, and the grandest display of the night was presented by the appearance of the "merry dancers." The space over which they frolicked was not so extended as that occupied by the previous display, 60 degrees of the horizon would embrace its eastern and western limits, the "polar star" was observed to be in the exact center of this group of luminous beams which were arranged very closely and though slender, presented unbroken outlines as they reached up to zenith, where they seemed to converge as if forming the ribs of a great dome; along the base of these columns was a dark slate colored segment which terminated at 150° above the horizon; from behind this segment horizontal flashes of light rolled up in rapid and successive waves along the luminous beams; these were the "merry dancers." The "polar star" was noted again and none of these waves were seen to pass it, most of them vanished when within 10 degrees of it. This, the grandest display of series of the late phenomenon was of about the same duration as the others, again came the usual familiar sky, and shortly afterwards the twilight arc pro-

claimed that the orb of day was approaching, before whose light all luminaries should pale, and so ended the auroral display of that night, but not until a fitting "finale" was had by a merry dance. The basis of the auroral light is electricity, in fact it may be considered an electric light. True, it is not so brilliant as the light of the same name as that produced by mechanical appliances. This is owing to the diffusion of electricity over a space of great extent, while in the case of the artificial light the electricity is concentrated and the arc of light instead of being diffused is made to flash from one point. That the air is highly charged with electricity during the existence of auroral displays, has been amply verified by the difficulty experienced during Sunday by telegraphers. The dispatches traversed the wires during the active displays in a confused and unintelligible manner, and at times the magnets were almost solely under the influence of nature's great electric battery the "Aurora Polaris."

VARIETIES OF AURORA.

Auroras exhibit an infinite variety of appearances, but they may generally be referred to one of the following:

First—A horizontal aurora or break of day. The polar light may be distinguished from the true dawn by its position in the heavens, since in the United States it always appears in the northern quarter.

Second—An arch of light somewhat in the form of a rainbow. This arch frequently extends entirely across the heavens from east to west, and cuts the magnetic meridian nearly at right angles. This arch does not long remain stationary, but frequently rises and falls; and when the aurora exhibits great splendor several parallel arches are often seen at the same time, appearing as broad belts of light stretching from the eastern to the western horizon.

Third—Slender luminous beams or columns, well-defined and often of a bright light. These beams rise to various heights in the heavens, sometimes, though rarely, passing the zenith. Frequently they last but a few minutes sometimes they continue a quarter of an hour, a half hour, or even a whole hour—sometimes they remain at rest, and sometimes they have a quick, lateral motion.

Fourth—The coronæ luminous sometimes shoot up simultaneously from nearly every part of the horizon and converge to a point a little south of the zenith, forming a quivering canopy of flame, which is called the corona. The sky now resembles a fiery dome, and the crown appears to rest upon variegated fiery pillars which are frequently traversed by waves or flames of light. This may be called a complete aurora, and comprehends most of the peculiarities of the other varieties. The corona seldom continues complete longer than an hour. The streamers then become fewer and less intensely colored; the luminous arches break up, while a dark segment is still visible near the northern horizon, and at last nothing remains but masses of cirro-cumulus clouds.

Fifth—Waves or flashes of light. The luminous sometimes appear to shake with a tremulous motion; flashes like waves of light roll up toward the zenith, and sometimes travel along the line of an auroral arch. Sometimes the beams

have a slow lateral motion from east to west. These sudden flashes of auroral light are known by the name of the "Merry Dancers," and form an important feature of nearly every splendid aurora.

The color of the aurora is very variable. If the aurora be faint its light is usually white, or a pale yellow. When the aurora is brilliant, the sky exhibits at the same time a great variety of tints; some portions of the sky are nearly white, but with a tinge of emerald green; other portions are of a pale yellow or straw color; others are tinged with a rosy hue, while others have a crimson hue, which sometimes, but rarely, deepens to a blood red. These colors are ever varying in position and intensity.

There was another display on Thursday morning ult., lasting from after midnight until daybreak, with recurring fits of activity, but not so brilliant or extending over so much of the heavens as that of Sunday night. Although somewhat similar, with the exception that the phenomenon of the "Merry Dancers" did not occur during the display.

A remarkable and very rare phenomenon occurred during this display, viz: The sky became obscured and a light shower of rain fell from 1:35 A. M. to 1:45 A. M., shortly afterwards the sky became clear, and disclosed auroral activity simi ar to that of Sunday night, but not extending to so high an altitude. The highest beams did not reach above 60°, nor were the colors as brilliant or so well defined.

COMETS.

R. J. M'CARTY, KANSAS CITY, MO.

Such is the magnificent aspect of comets, such their shape, so remarkable the contrast between them and the surrounding stars, so capricious do they seem in their movements, so seldom do they appear and so quickly do they vanish, that it is by no means strange that their appearance should fill the ignorant with alarm and the wise with admiration and curiosity.

Previous to the apparition of the celebrated comet of 1680, we may say nothing was known of the motions of these extraordinary bodies, except that they had been observed to make their appearance among the stars, approach the sun for a certain time, and then recede until lost in the depths of space.

In elaborating the principle of gravitation, Sir Isaac Newton had demonstrated that any body revolving about the sun under the dominion of that principle must describe some one of the conic sections, with the sun at its focus, and that the particular conic described would be determined solely by the velocity of the body at any given point of its orbit. I have here a cone so cut as to show the curves alluded to.

A body moving with a velocity equal to that which it would acquire by falling directly to the center of the sun (supposing the attraction of the sun for the

body not to vary as the distance diminished) will move in a parabolic orbit. If the orbital velocity be less than this, the body will move in an ellipse. If it be greater, the orbit will be an hyperbola, the sun in every instance being situated at the focus.

For that portion of this theorem relating to elliptical orbits Sir Isaac Newton found immediate application in our planetary system, and his wonderful sagacity had anticipated that its more general application would be found in the motions of comets. The appearance of the great comet of 1680 afforded him a most excellent opportunity. He found this comet to move in an orbit which, if an ellipse, was so greatly elongated as to be undistinguishable from a parabola. The period of this comet is estimated at 575 years, and it is supposed to be identical with the comet of 1194 B. C.; with that of 618 B. C.; with that of 43 B. C., which was supposed to be the soul of Cæsar taking its place in heaven; with that of A. D. 575, which was seen at noonday close to the sun; and with the magficent comet of A. D. 1105.

Applying the above theorem to the comet of 1682, Sir Edmund Halley was led to predict its reappearance in 1759—a prediction fully justified by the event. This comet again appeared in 1835, and is again due at its perihelion in 1910.

Since the year 1680 several comets have appeared which were found to move in hyperbolic orbits, viz: those of 1723, 1771, and the second comet of 1818.

Now, since the parabola and hyperbola are curves of infinite length, it is evident that comets moving in either of these could never before have visited our system, nor is it possible that they should ever return. Again, it is found that while all the planets revolve around the sun in the same direction and nearly in the same plane, *comets* move in any direction and in planes greatly inclined to each other, which shows that they cannot be regarded as permament members of our system.

It is interesting to speculate upon the career of a comet which moves in an orbit of infinite length. We cannot but think, as it has visited us on one branch of such a curve to retire on the other, that at some time in the past it must have swept around some fixed star or sun, whose distance can be measured by no means at our disposal, and that on its outward journey it will reach a point at which the attraction of some other fixed star will predominate and cause the comet to visit it, just as it did our sun. And as these comets may thus in time traverse the utmost bounds of space in search of equilibrium, so may, and so does, our ponderous sun himself obey the same law and traverse space about some unknown center of force; and thus is it possible that he may now be moving in a cometary orbit, from which he will ultimately be deflected into a planetary by some sun mightier than he, and by the process of cooling and perturbation be reduced to the state of a planet, while the planets of his own system will become his satellites. If such a speculation be admissible, it is easy to see that in time all matter would be caused to revolve around a common center, and all systems would be reduced to one.

The motion of a comet as it recedes from the sun becomes slower and slower, so that comets of parabolic or hyperbolic orbits may reach such a great distance that their motion may be but a few feet per second. Now, such is the immense distance of the fixed stars that such a velocity may obtain before any one of them would exert a predominant influence upon the motion of the comet; and this, it is reasonable to suppose, is generally the case.

If, now, we remember that the form of orbit is determined by the velocity, we are led to suspect that, generally, comets leaving our system on hyperbolic or parabolic orbits will visit other systems on ellipses, and that comets leaving other systems on these infinite curves would be most apt to visit us in ellipses. This may explain why so few of the comets which approach the sun move in hyperbolic orbits. Since there can be but one velocity which gives a parabolic orbit, while an increase or diminution of same would give either an hyperbola or an ellipse, we may assume that few if any comets ever moved in strictly parabolic orbits. And should a comet at any time move on a parabola, it would soon be forced to abandon it for either an ellipse or hyperbola by the attractions of other bodies.

There is great difficulty in determining the exact orbits of comets: First, because (as will be shown further on) comets are very light bodies, and therefore their motions are subject to great derangements from the attractions of the planets. Second, because in most cases they can be observed while traversing only a small portion of their orbits. By lengthening out an ellipse it may be made to approach more and more nearly to the form of a parabola, so that if the two be placed with their vertices touching, they may be made to coincide for a greater and greater distance. It will be seen, therefore, that if a comet can be observed only while it is within the limits of this coincidence (which is always the case with comets of so-called parabolic orbits), it is impossible to determine the orbit beyond. A good illustration of this is afforded in the theory of projectiles. We are taught that, neglecting the resistance of the air and the motion of the earth, a body projected in any direction except vertically will describe a parabola. Now, in order that a body so projected should describe this curve, it must be given a velocity equal to that which it would acquire by falling to the center of the earth, supposing all the matter in the earth collected at that point, and the acceleration to be constantly equal to 32.2 feet per second. This would be about seven miles per second; and since no such velocity can be given to a projectile, it is evident that they all move in ellipses so very much elongated that there is no objection to regarding them as parabolas.

The difficulty, therefore, in calculating the orbits of comets is not caused by any defect in theory, is not because these bodies refuse to obey the same laws which control the motion of all matter; but simply because it is not always possible to obtain sufficient data. While science has thus reached the motions of comets, and shown them to consist of inert matter, obeying the general laws of motion, it has been able to postulate little with regard to their physical constitution.

Situated in the head of a comet is a bright nucleus like a star; next this and

surrounding it is a comparatively dark substance, and next this last is a bright envelope which covers the head of the comet on the side next the sun, and trails off into space forming that remarkable appendage which renders these bodies so conspicuous. This train or tail is in some instances projected to the most enormous distances—that of the comet of 1680 attaining the length of 123,000,000 miles—a distance much exceeding that from the earth to the sun.

The process of forming the nebulous envelopes and the tail often results in giving to comets the most gigantic dimensions—the volume of the great comet of 1843, for instance, including, of course, its tail, being at one time more than three times that of the sun. This immense size indicates either a vast amount or an extreme tenuity of cometic matter. That these bodies contain but a small quantity of matter was shown in the case of Lexell's comet of 1770. Lexell had calculated the period of this comet to be about five and one-half years, yet the comet has never since been seen.

In seeking for the cause of its failure to appear as expected, it was found that on the occasion of its first return in 1776 it was completely hidden by the rays of the sun, and that in 1779 it approached so near the giant planet Jupiter as to become, as it were, entangled among his moons, the effect of which rencontre was to deflect the comet entirely out of its orbit, so that it either no longer moves around the sun in an ellipse, or if so, does not approach sufficiently near to become visible to us. While the comet was so remarkably affected there was not the slightest visible change produced in the motions of any of Jupiter's satellites, which must have resulted had the mass of the comet been at all comparable with that of those small bodies.

We have seen that the volume of the great comet of 1843 was more than three times that of the sun.

Now the earth is about 5,000 times as dense as ordinary air and the sun about one-quarter the density of the earth but contains about 314,000 times as much matter—so that if the great comet of 1843 had been of the mean density of ordinary air it would have contained nearly 1,000 times as much matter as the earth. Now if this comet was at all analogous to that of Lexell, and there is every reason to believe so, it could not have contained the $\frac{1}{1000}$ part of the mass of the earth, so that its mean density probably did not exceed the $\frac{1}{1000000}$ of the density of the air we breathe.

Comets being thus known to be bodies of small mass and great size it is natural to suspect them to consist principally if not entirely of gas. There is some question, however, as to whether a body composed entirely of gas could exist in outer space: some holding that the repulsive properties of such a state of matter would dissipate it indefinitely, to be disrupted and appropriated by bodies more dense and rigid. Against this it may be said that "Marriotte's Law of the Compression of Gases" indicates that the expansive force of a gas diminishes as the *cube* of the distance between its particles increases, while the gravitation of these particles toward each other is known to diminish as the *square* of their distances from each other increases. So that the expansion of a gaseous body in

outer space would be arrested within finite limits by the gravitation of its particles.

I am led to present the two sides of this question from a remark in a very able and interesting essay on Comets by Professor Lewis Boss, of the Dudley Observatory, published in the April number of the KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY, where he states that "It is certain that no body entirely gaseous could exist in space."

With all due respect to the learned Professor I will say that science seems to answer the question differently. It is, however, generally conceded that while they are not composed entirely of gaseous matter, to some degree gas is present in cometary structures. Again it has been ascertained that comets shine in some degree by native and in some degree by reflected light, and the weight of scientific opinion is in favor of regarding the bright nucleus as a solid or liquid body in an incandescent state. Therefore, if we, for instance, suppose a comet freed from that influence which produces its tail we would have a body consisting of a glowing mass at the centre and surrounded by a highly attenuated substance shining partly by reflected light.

This is in fact the shape to which comets generally approach as they recede from the sun; in which, it is believed, lies the agency which produces the tail. A total eclipse of the sun reveals that he is surrounded by a luminous envelope, to which the name of "corona" has been given, which has been perceptible for a distance of 850,000 miles from his surface. In addition to this, luminous streamers have been observed proceeding in directions perpendicular to the surface of the sun to a distance of nearly 2,000,000 miles, as if expelled by some active force. Both corona and streamers have been found to shine partly by reflected light

Taking this view of the sun we find it to consist of a glowing mass surrounded by an apparently gaseous substance shining in part by reflected light. This is precisely the condition to which we reduced the comet by freeing it from the agency which generates the tail. We may then reasonably carry the analogy further and conclude that the nucleus of a comet corresponds to the photosphere of the sun and that the nebulous envelope corresponds to the corona observed in eclipses. Also that as the phenomena of sun-spots indicate that within the shining photosphere of the sun is a darker mass which is in some manner protected from intense heat, so there may be within the bright nucleus of a comet a similar mass similarly situated and protected.

When it is remembered that the great comet of 1680 was subjected to a temperature of more than 2,000 times that of red-hot iron, a temperature capable of dissipating any known substance, this supposition does not seem unreasonable. Again, it is believed that the photosphere of the sun is composed of gas. If, then, the bright nucleus of a comet is analogous to it, the latter must be inconceivably less dense than the former, owing to the vast difference between the mass of the sun and that of a comet, and this may explain why the nuclei of some comets are transparent, and why they diminish in size with an increase of telescopic power. Again, it is as yet a unanswered question as to what maintains the heat

of the sun, and if the nuclei of comets are glowing masses, the question is more pressing owing to the small quantity of matter which they contain. Moreover, the luminous streamers from the sun alluded to above would seem to indicate the presence of that agency which produces the tails of comets, and also would seem to explain some phenomena exhibited in the heads of comets.

There are are other analogies between the sun and comets which could be cited, but I think enough has been said to show it probable that comets are similar to the sun in physical composition. We will now give back to the comet its tail and briefly consider the cause of that wonderful phenomenon.

There seems to be no room for doubt that the agency which generates the tail of a comet must be sought in the sun, and that it consists of a repulsive force exerted by that luminary upon the nebulous envelope of the comet. This is supported in some cases by calculation. The tail of Donati's Comet of 1858 having been found to be nearly the shape which it would have taken under the operation of a repulsive force exerted by the sun.

Now, as this repulsion begins to act, assuming the nebulous matter of the comet spherical to begin with, it would naturally cause this substance to bank up between the nucleus and the sun, thus increasing its temperature and density and making it more luminous than any portion of the comet except the nucleus: thus forming what is called the nebulous envelopes. This repulsive force may be electrical, as has often been supposed, or it may be that same force which projects the luminous streamers from the surface of the sun, but whatever it is, it is impossible that it alone could produce all the phenomena which are presented in the tails of comets; because, generally, while the tail of a comet is single—it is turned directly from the sun and slightly curved toward that region of space which the comet has just left, and while its magnitude is greatest when its distance from the sun is least—there are exceptions to every one of these particulars.

The analogy between the physical constitution of our sun and that of comets, which I have endeavored to establish, would indicate that the same agencies exist in comets that exists in the sun and that it is to the conflicting or co-operation of these forces, to the different modes and directions of their action, that we owe the variety of phenomena presented by different comets and by the same comet at different times.

FACTS AND FANCY CONCERNING COMETS.

BY PROF. E. L. LARKIN.

At intervals of considerable regularity the press is burdened with accounts of impending disaster. Some dire astronomical event is always about to occur that will annihilate the human species. A Chicago writer, oblivious of the laws of gravity and motion, predicted evil to the earth to fall on June 19, 1881, and published a diagram of the solar system as it would appear on the eventful day. The earth

was to suffer because it would be on one side of the sun, while the large planets on the opposite would so attract our world as to attract earthquakes, pestilence and death. So dense was the ignorance of the alarmist, that he actually diagramed Venus on the wrong side of a sun, in a position in which it would not arrive for more than six months. June 19 came and was all serene, but we read of some being rendered insane by these publications. And now it is sought again to awaken fear by the formulation of predictions of appalling heat that is to reach the earth, because the great comet that illuminated the circumpolar heavens last summer passed perihelion at a point close to the sun. The scheme to destroy mankind is that the comet on its return in 1897, will suffer sufficient retardation in passing through the gases constituting the corona of the sun to cause it to fall. Inconceivable heat will be generated from the arrested motion, and waves of it will surge against the earth, literally burning humanity alive. All such doctrines are without the slightest grounds in reason or scientific deduction, and the mystery is why any man pretending to astronomical or mathematical acquirements will print such dogmas.

If we raise a mass weighing 772 pounds 1 foot, and then let it fall, the precise amount of power required to raise it will be restored, and will appear in the form of heat, at the instant of impact of the mass on the earth. And, as has been proven, the amount of heat generated is just enough to raise the temperature of 1 pound of water 1° F. But the heat evolved by the fall of 772 pounds 1 foot is equal to that developed by the fall of 1 pound 772 feet. A mass weighing 1 pound that has fallen 772 feet has motion sufficient to conserve heat enough to heat 1 pound of water 1°; or 1 pound of water falling 772 feet generates 1° of heat throughout its mass. This is termed Joule's heat equivalent, and is a valuable element of human knowledge. It is a postulate of recent science that when one mode of force vanishes, another of equal intensity takes its place. Force cannot be increased or diminished; it is one of nature's constants. Motion is a mode of energy, and, invariably, when it terminates, heat—another form of force—appears.

Now, what possibly can be of greater moment than to learn how much motion is required to evolve 1° of heat. We know how great a weight, and how much space; but now comes the question, how rapid must be the motion? The velocity acquired by a falling body at any instant of its fall is equal to the square root of the product of twice the force of gravity and the space fallen through. If a body be let fall, it will be found by delicate instruments to be moving, at the close of 1 second, with a velocity of 32.2078 feet per second. And this velocity is an expression for the force of gravity exerted by the mass of the earth on bodies near its surface. By the rule, 32.2078 multiplied by 2 equals 64.4156, and this multiplied by 772 equals 49,729 feet, whose square root is 223. Of all numbers known to man for purposes of physical research, this 223 is the most important; for we now know that 1 pound of matter moving with velocity of 223 feet per second generates heat enough, when its motion ends, to heat 1 pound of water 1°. That is, this velocity represents 1 pound-degree of heat, or simply 1°,

water being unity. With this magic number, all depths of space may be explored, and it can at once be told how much heat will be evolved by the cessation of motion of any cosmical body, as soon as it is learned how fast it is moving.

Having now the heat unit of the universe refined down to definite velocity, we are ready to launch into interstellar space, to learn first the velocities of bodies moving therein, and, secondly, to calculate the intensity of heat capable of being developed if the motion should be brought to a rest. The rule for finding the amount of heat evolved by the termination of motion is: Multiply the square of the velocity in feet per second by the reciprocal of the square of 223, or .00002010899.

If a mass of matter fall from an infinite distance, with unimpeded motion, and strike the earth, its velocity at the instant of impact is equal to the square root of the product of twice the intensity of gravity multiplied by the length of the radius of the earth. And this motion at the moment of collision must be found in feet per second, because the unit of measurement is 223 feet per second. Twice the force of gravity is 64.4156, and the mean equatorial radius of the earth is 20,923,161 feet. The square root of the product of these numbers is 36,645 feet, or 6.94034 miles per second, velocity acquired by a mass falling on the earth from a distance that is infinite. The force of gravity on the surface of the sun is 27.696 times stronger than on the earth's surface while the radius of the sun is 108.5113 times greater than that of the earth. Therefore, by the law of gravity, the velocity of impact of cosmic matter on the sun must be 54.8208 times more rapid than on the earth. This is known, because the square root of the product of 27.696 and 108.5113 is 54.8208, whence 36,645 multiplied by 54.8208 gives 2,008,908 feet, or 380.0962 miles per second velocity with which a mass would strike the sun after falling from an infinite distance. And this inconceivable motion must all be converted into heat at the instant of collision. Now, square 2,008,908, multiply the product by .00002010899, and we have the appalling heat of 81,154,081° F. as the intensity generated by cometary or other cosmic bombardment of the sun by masses that fall from infinite distances. Some sensational writers, having heard of this, at once seek to alarm all timid people by printing outrageous accounts of the impending destruction of man. Such publications are little better than criminal.

What we have said relates to bodies making impact on the sun after reaching it from distances that are infinite; now; how great velocity will be imparted to masses falling from distances that are finite, and capable of being handled by figures? Distance in relation to solar gravity has peculiar properties, thus: The nearest sun to ours is 20,000 000,000,000 miles away; let us go out into space half way, or 10,000,000,000,000 miles, and make computation, seeking to learn with what velocity a mass beginning to fall from that point will finally strike the sun. The velocity, 2,008,908 feet per second, is called the solar constant of velocity, and many complicated problems wherein gravity and motion are factors, can be solved in a few minutes by its use. Employing it in a calculation for a radius 10,000,000,000,000 miles, and carrying out the work into minute decimals,

we shall be surprised to find that the velocity of impact on the sun, by a mass falling that distance, is only one-fourth of an inch less per second than if it came from an infinite distance, or, what is the same thing, had been falling forever! Surprise will wane, however, when it is remembered that gravity varies as distance squared inversely, and at an infinite distance must be infinitely weak, and the motion it can impart infinitely slow. Hence, 10,000,000,000,000 miles has nearly the same relations to solar gravity that infinite space has. Drawing nearer the sun, let us halt at the orbit of Neptune, 2,780,000,000 miles distant, and again apply the formula; when behold, if a mass fall through the distance of Neptune, it will reach the sun with only 155 feet per second less velocity than if it had been falling throughout all duration of time. Still nearer, we come to the orbit of the earth, 92,000,000 miles from the sun's center, and, again computing, find that final velocity of impact on the solar globe of matter from terrestial distance, would be but 2,411 feet per second less than if it arrived from infinite space. By the use of this important number, 2,008,908, it can at once be told what is the velocity of any cosmical mass at any point in its flight to the sun. Calculating for the earth's distance, it is found that a body passing our world on its way to the sun has a velocity of twenty-six miles per second, which is the greatest velocity with which anything can strike the earth. Arriving at the orbit of Mercury and again calculating, we find that a mass beginning to fall from that distance, 36,000,000 miles, will impinge on the sun with a rate of motion only 5,706 feet per second less than if it had been falling forever. Hence, terminal velocities lies within small limits of variation. Here is a table of velocities in feet per second of bodies making impact on the sun, falling different distances:

From infinite distance, maximum	2,008,908
From Neptune	2,008,753
From Mars	2,007,361
From the Earth	2,006,497
From Mercury	2,003,202
From 436,000 miles, minimum	1,420,513

It is seen that interstellar matter, whether colliding with the sun from infinite fall, or from Mercury, has 5,706 feet, a trifle over 1 mile per second difference in final velocity, variation being within the limits of 1-380 of the whole. The rate of the motion in the last line of the table is that attained by a mass falling on the sun from a distance equal to the solar radius, 430,000 miles, as we can not imagine that any cosmic matter will begin to fall from a less distance. Therefore, the least velocity of impact is 1,420,513 feet, or 269 miles, per second, and this least motion multiplied by 1.414213 equals 2,008,908 the greatest, hence the maximum and minimum velocities are to each other as 1 is to the square root of 2, or as 1 is to 1.414213.

If we square 1,420,513 and multiply the reciprocal of the square of Joule's equivalent, as above, we obtain the least heat possible, or 40,577,090° F. What astonishing results are brought to light by these researches. Incredible intensity

of heat, the highest being 80,000,000° and the least 40,000,000°! What effect will such outbursts of thermal energy have on the earth? Will the heat vaporize the oceans, parch the land, and consume all organisms? Let us see. First, we must find the relations between velocity, heat and mass. Take any mass at random, say 52 pounds, and give it any velocity, say 892 feet per second, how intense will be the heat evolved when its motion ends? By analysis, 1 pound moving 223 feet per second has a motion sufficient to generate heat enough to increase the temperature of 1 pound of matter of the density of water 1°, hence if it moves 4 times as fast, or 892 feet, it has motion able to develop heat 16 times more intense, or 16°, because the square of 4 is 16 times greater than the square of 1, the ratios of their velocities.

If a mass weighing 1 pound, moving 892 feet per second, generates on impact 16°, fifty-two pounds will evolve fifty-two times that amount, or 832°, but the heat will still have the same intensity. By thermometer the mass will indicate only 16°,—that is, fifty-two pounds moving 892 feet per second can generate heat enough to heat one pound of water 832 degrees, 832 pounds 1°, or fifty-two pounds 16°. Now double the mass, by making it 104 pounds, the velocity remaining the same, and we double the quantity of heat and will have 1,664°; still the thermometer reads 16 degrees. The 1,664°, being distributed through twice the mass, can have no greater intensity than that conserved from its velocity. Therefore:

1. Increase of mass does not increase the intensity of heat. If we double velocity instead of mass the heat is quadrupled in intensity, thus: 892 multiplied by 2 equals 1,784, and the square of two is four times greater than the square of one; and since heat of impact is proportional in intensity to squares of velocities, we have four times the heat energy, or 3,328° degrees in amount, and four times the intensity or 64°. This is because four times the heat raises the temperature of fifty-two pounds four times 16°, or 64°, the3,328° degrees being able to warm 3,328 pounds 1°, one pound 3,328°, or fifty-two pounds 64°. Whence:

2. Heat depends for intensity on velocity, and not on mass. Let one pound of matter strike the sun, and whether it fall from an infinite distance or from the distance of any planet its motion will develop on collision, in round numbers, 80,000,000°; let a mass of two pounds impinge, and double the amount of heat will appear, but its intensity will be the same, since the final velocity cannot be more than 380.0962, nor less than 379.3943 miles per second. Thence:

3. A comet of great mass colliding with the sun will produce no greater intensity of heat on the sun or earth than one of small mass. Velocities of impact mentioned are those of interstellar masses falling on the sun with unimpeded motion on straight lines. Any comet that can make impact must move around the sun many times before it can collide, its perihelion at each circuit approaching, until finally it is so far retarded by gases in the vicinity of the sun that its orbit comes to almost coincide with the solar surface. Then, if the nucleus is solid, it will ricochet like a cannon-ball, and surrender portions of its heat at

each impact, nothing like 80,000,000 degrees being developed at any point. When:

4. Maximum heat can not appear unless cosmic matter fall on right lines to the sun, and not on curves. Heat is now known to be a mode of atomic motion; the greater the rapidity of atomic oscillation the more intense the heat. The reason why a mass on collision evolves heat is because the motion of the whole mass through space is instantly arrested, and massive motion becomes atomic. When the body is moving, each atom in it maintains constant relation to all the others, and no heat is developed. Let the mass strike a solid and each atom begins motion in relation with every other, the instant translation through space ends. If the velocity of impact is great, atomic motion is most rapid, and the heat intense. If the collision is not powerful enough to cause every atom to shift position, all the heat possible will not appear. Let a rifle ball strike a rock, every atom of the lead changes location, the ball is flattened, and, if velocity is sufficient, melted. But if it strike a mass of cork, resistance being so slight, the lead atoms will not shift nor heat appear. Behold the sun; its density is only 1.44, that of water being one, or about the consistency of calcimine applied to our ceilings. A comet would plunge thousands of miles beneath the liquid surface of the sun, and the heat would slowly radiate away, benefitting man instead of destroying him. Therefore:

5. Eighty million degrees of heat can not develop unless the sun becomes rigid as platinum and cometary nuclei solid. But it is not on these arguments that we rely. We will grant that comets can fall upon the sun, developing maximum heat, allowing alarmists the worst, and then demonstrate that such impact can not affect the earth in any way except for good. If we burn fifty pounds of coal in one hour it will radiate genial heat, and an iron bar suspended, say, at a distance of four feet from the fire will be warmed through, supposing it to be an inch in thickness. Now, put on a blast and consume the coal in one minute; the bar will not be warmed throughout. Consume the coal in one second, and the surface only of the bar next the fire will be warmed. Burn the coal in the millionth part of a second, the same amount of heat will be given out as when one hour was occupied in the combustion, but the human hand could be held in place of the bar and not feel pain. The heat would be intense, but of such inconceivably short duration that it would not destroy the structure of one's hand. Whence time is a factor in all problems where the action of heat is concerned. Now, let a mass in motion at the rate of one foot per second collide with the sun, and we say the time consumed in impact is such a part of a second; but let it move 2,008,908 feet per second, the time of collision is 2,008,908 times shorter, and the heat that many times more intense, the intensity of the heat depending solely on the time of impact, and the time directly on velocity. Hence:

6. The intensity of 80,000,000 degrees exists less than the 1-2,008,908 part of a second, and the heat-wave that can strike the earth will have the same duration. Heat, light, or any other energy emanating from a center varies in the

inverse ratio of the square of the distance. The earth is 92,000,000 miles from the sun, but to arrive at results, a ratio must first be deduced. Suppose that above where the comet strikes we place a flat surface at a distance of 100,000 miles, and admit that the radiation of heat hereon from the disintegrated comet would be 80,000,000 degrees. Of course it would not be that intense, for of such intensity is the heat 100,000 miles below; but allow that it would be, then how intense will be the heat reaching the earth? The quotient of 92,000,000 divided by 100,000 is 920, and the square of this number is 846,400. Then, the heat falling on the earth is 846,400 times less than that radiating on a surface 100,000 miles from the scene of collision. Dividing 80,000,000 degrees by 846,400 we find the intensity of a heat-wave that can reach the earth from the disruption of any comet large or small on the sun to be 94 degrees. Take a hot day with the thermometer at 94 degrees, double the heat for the 1-2,008,908 part of a second, or indeed for half a minute, and observe the effect on the human species. Really the only way to detect the arrival of the wave would be to turn a large telescope on the sun just before the comet fell, and place in the focus one of Prof. Langley's balometers capable of measuring the 1-50,000 degree of heat, and look intently on the index with a microscope. Even then it is doubtful if movement of the delicate balance could be seen. We should be pleased to have our telescope set upon the precise point of impact at the time the comet falls to see what would take place. It is scarcely possible that a movement so rapid would make impression on the retina. And high magnifying powers would have to be used, since one second of arc on the solar disc is in linear dimensions 450 miles, and is as small an object as can be seen in a telescope on the sun. But the comet of 1811 had for what was supposed to be a solid nucleus a diameter of 428 miles—less than one second of angular measurement when at the sun's distance; hence the final plunge of a comet into the solar flames could only be seen in good telescopes under favorable circumstances. But a tele-spectroscope of powerful dispersive powers set on the spot after impact might in the spectrum produced exhibit slight disturbance, such as displacement of the lines caused by outbursts of hydrogen and other gases. Hence:

7. The effect of cometary precipitation on the sun can not be detected on earth save by the most powerful instruments. What is the sun? It is a colossal ball 860,000 miles in diameter, whose mighty mass is 331,654 times greater than that of the earth. What is a comet falling into this awful furnace? Nothing but as one firebrand in the conflagration of Chicago. Explosions are always taking place on the sun, causing greater upheaval than the downrush of a dozen comets. Can cometary collision on the sun injure man? Indeed, such impact serves to keep him alive. The sun does not radiate too much heat now, and astronomers are agreed that part of the present supply is kept up by cosmical bombardment. We are flung away in some nook of the universe chained to an expiring world—a home that is already suffering encroachment of polar ice. We exist only by the heat of the sun. The real danger lies not in cometary downrush, but in the fear that not enough meteors and comets will gravitate into solar fires. The longer

comets continue to strike the sun, the longer can man inhabit the earth. We thought it the province of science to dispel superstition and fear; and least of all did we think that astronomy would be made use of as an engine of terror. We put in a plea for pure astronomy, and urge that its truths be not tampered with by sensationalists. Interstellar matter perpetually bombards the sun, each collision of meteoric hail sending to earth life-sustaining heat. We trust this cosmic war will not cease, and that at least one comet per week will dash on the sun during the next ten thousand years.

ASTRONOMICAL NOTES FOR MAY, 1882.

BY W. W. ALEXANDER, KANSAS CITY, MO.

THE SUN.

Date.	Right Ascension.	Declination N.	Equation of Time.
1st.	2h. 35m.	15° 11′	3m. 04s. —
5th.	2 50	16 21	3 29
10th.	3 09	17 43	3 48
15th.	3 29	18 57	3 52
20th.	3 49	20 03	3 42
25th.	4 09	21 01	3 18
31st.	4 33	21 58	2 34

Apparent semi-diameter on the 1st, 15′ 54″; on the 31st, 15′ 48″.

THE MOON.

Date.	Right Ascension.	Declination S.	Semi-Diameter.
1st.	13h. 30m.	12° 40′	15′ 09″
5th.	17 05	21 15	15 43
10th.	21 47	7 44	16 03
15th.	2 19	16 01 N.	16 00
20th.	7 02	18 54	15 15
25th.	10 57	1 07	14 49
31st.	15 50	20 06 S.	15 38

MERCURY.

Date.	Right Ascension.	Declination N.	M. T. of Transit.
1st.	2h. 40m.	15° 33′	11h. 58m. A.M.
5th.	3 06	17 57	12 P. M.
10th.	3 49	21 23	35
15th.	4 32	23 50	58
20th.	5 10	25 12	1 17
25th.	5 43	25 38	1 30
31st.	6 15	25 10	1 39

Apparent diameter on the 1st, 5″; on the 31st, 8″.

By the end of the month it will be near its greatest elongation East, and will be visible in the West after sunset for 1h. 30m.

VENUS.

Date.	Right Ascension.	Declination N.	M. T. of Transit.
1st.	3h. 46m.	20° 06′	1h. 07m. P. M.
10th.	4 32	22 31	1 18
20th.	5 25	24 12	1 31
25th.	5 51	24 36	1 38
31st.	6 23	24 42	1 47

MARS.

Date.	Right Ascension.	Declination N.	M. T. of Meridian Transit.
1st.	7h. 55m.	23° 41′	5h. 17m. P. M.
10th.	8 15	21 36	5 03
20th.	8 37	20 13	4 44
31st.	9 01	18 27	4 26

Apparent diameter on the 1st, 6.2″; on the 31st, 5.4″.

JUPITER.

Date.	Right Ascension.	Declination N.	M. T. of Transit.
1st.	4h. 01m.	20° 00′	1h. 22m. P. M.
10th.	4 09	20 24	0 56
15th.	4 13	20 37	0 41
20th.	4 18	20 50	0 26
25th.	4 23	21 02	0 11
31st.	4 29	21 26	11 57 A. M.

Apparent semi-diameter on the 1st, 15.8″; on the 31st, 15.5″.

SATURN.

Date.	Right Ascension.	Declination N.	M. T. of Transit.
1st.	2h. 52m.	14° 22′	0h. 15m. P. M.
10th.	2 57	14 43	11 41 A. M.
20th.	3 02	15 04	11 07
31st.	3 07	15 27	10 29

Apparent semi-diameter on the 15th, 7.7″.

URANUS.

Date.	Right Ascension.	Declination N.	M. T. of Meridian Transit.
1st.	11h. 4m.	6° 48′	8h. 25m. P. M.
16th.	11 3	6 51	7 26
31st.	11 3	6 50	6 27

NEPTUNE

16th.	2h. 58m.	15° 10′	11h. 18m. A. M.

PHENOMENA.

On the 2d, at 1h. oom. A. M., conjunction of Mercury and the Sun superior.

On the 4th, at 1h. oom. A. M., conjunction of Mercury and Saturn. Mercury north, 2° 22′.

On the 5th, at 1h. oom. A. M., conjunction of Venus and Jupiter. Jupiter south, 2° 16′.

On the 18th, Mars in Præsepe.

On the 18th, at 7h. 04m. P. M., conjunction of Venus and the Moon. Venus north, 2° 45′.

On the 22d, at ooh. oom., Neptune stationary.

On the 22d, at 7h. 14m. P. M., conjunction of Mars and the Moon. Mars north, 6° 46′

On the 31st, evening, conjunction of Mercury and Venus. Mercury west northwest, 1° 43′.

GEOGRAPHY.

THE JEANNETTE AND HER SURVIVORS.

The following account of the preparation, voyage and loss of the Jeannette and the subsequent wanderings and sufferings of her survivors has been compiled from various authentic sources, and is believed to include all of the more important events of the expedition up to the present time.—[Ed. REVIEW:

That part of Siberia extending from the Taimur Peninsula to Behring's straits is universally conceded to be one of the most desolated, frigid, and worthless sections of country that can be imagined, and one that is wholly devoid of anything to sustain life, except from the precarious supplies of fish and sea animals found in the Arctic Sea. Consequently, except for a few brief weeks in summer, even the iron-framed nomads of that region, Samoides, Ostiaks and Tongoose, all leave the sea coast and seek in the wooded tracts hundreds of miles from the sea that protection and that relief which the intense cold requires in the long, cold Siberian winter.

From about 1620 until a very recent date in this country the Russians have sent scores of expeditions to survey and examine those gloomy, cold, inhospitable regions of the "Summa Arctus," which, to this day, is yet what Pliny and Pomponius Mela 1,600 years ago said it was: "Beyond the Caspian Sea and the coast of the Scythian Ocean the land projects to the east. The first part of this coast from the Scythian Promontory (Taimur) is not habitable for the snows. The land next adjoining is uncultivated from the ferocity of its inhabitants. These are Scythian anthropophagi and the Sacae. Near them are vast solitudes and

multitudes of wild beasts. Everything here is ferocious, beginning with man. Beyond these solitudes are deserts, peopled with wild beasts, as far as a ridge or mountain hanging over the sea, which is called Tabin (probably East Cape.)"

In 1735 an experienced and energetic officer, Lieut. Wasili Proutscheschew, was sent to survey the Promontory of Taimur and the Siberian coasts near the mouth of the Lena. This was completed in part in 1736, but on his return in the fall, Proutscheschew fell sick at Olenek, a Russian village on the shore of the Arctic Ocean, and died from grief and disappointment at his non-success. His wife, who had heroically followed him, died some few days after.

In 1738 Lieut. Chariton Laptiew took the place of Proutscheschew, but was not able any more than his predecessor to finish the survey between the Lena and the Yenesei. By sea the work was finished by a land party with full success.

To survey east of the Lena, Lieut. Lassennis and fifty-two men sailed in 1735 from Jakutzsk. He went that year along the coast to a small river between the Lena and Juna. There he wintered with his vessel, sending six men with dispatches to Jakutzsk. In that terrible winter thirty-seven men died of scurvy of the forty-six men left. When in June, 1736, assistance reached Lassennis, he and all his men were dead.

After this failure Lt. Dimitri Laptiew continued the survey from the Lena east, and examined the coast to the Kolyma River, and, as some claim, he finished a complete examination of the Siberian coast to East Cape and the Anadyr River, at the Anadirskoi Ostrog, but this has been denied, and that the Lieutenant made his examination of the route to Anadirskoi by land.

In 1760 '65 Shalauroff, an enterprising Russian, attempted to finish in person the exploration ended by Laptiew at the Kolyma River. He penetrated by following the coast to Tschaoon Bay, some 300 miles east. In 1764 in no manner daunted, Shalauroff again attempted to reach East Cape. He proceeded this time, it seems, from the inhabitable Lena. This expedition was never afterward heard from, except from rumors obtained from the Tchutzki, which was that Shalauroff and his men had all died near Cape Barannoi Kamen of starvation. Wrangell afterward substantiated this fact, as some huts were found where the unfortunate explorers had all died.

In the first portion of this century Baron Von Wrangell and Lieut. Anjew, both Russian officers, explored the coast from the Lena to near Cape Sendze Kamen, on the Arctic Sea, but did not succeed in rounding East Cape by water, which feat, since the passage of Deschnew and of Tara Staduchein in the 17th century, has not been done until 1878-'79, when it was completed by Professor Nordenskiold in the steamer Vega, who rounded the whole of Russia and Siberia from North Cape to Behrings Strait.

The Liakoff Islands were discovered in the last century by Sergeant Andreef in 1770, and by a merchant Liakoff in 1770, who followed the back trail of a herd of reindeer that had crossed from these islands to the main land of Siberia. Liakoff in 1773 repeated his trip and wintered there, gathering fossil ivory, some of the tusks measuring seven seven-twelfths feet long and weighing 115 pounds.

In 1806 one Sanikof, besides exploring the islands of Liakoff, also discovered Sanikoff Island, and what is now known as New Siberia. The Russian government, interested in these discoveries, deputed a savant named Hedenstrom, a Siberian, to make a report and more detailed examinations. In 1810 Hendenstrom went out north from the mouth of the River Jana and explored the coast 250 miles until he arrived at its eastern extremity. Hedenstrom thought that this was a prolongation of the American continent.

Omitting mention of numerous explorations in other portions of the arctic regions, we will take up only those of the more immediate predecessors of De-Long in the United States. The disaster which overtook the expedition of Sir John Franklin in 1847-8 gave a new impetus to Arctic adventure, and some of the most chivalric deeds which the historian of modern times has been called upon to chronicle are connected with the Polar voyages of the navigators dispatched to ascertain the fate of that gallant commander. The story of the perils through which these brave men pass, the sufferings they endured and obstacles they overcame, reads like a romance.

In 1850 no less than eleven separate expeditions were engaged in the search for the missing explorer, and in this year Henry Grinnell, of New York City, in conjunction with the Government, fitted out the first American expedition sent to the Arctic region, and under the command of Lieutenants Griffith and De-Harten the United States brigs "Advance" and "Rescue" carried the stars and stripes well into the regions of perpetual snow. The results attained by these various expeditions, however, were meager in the extreme, and science profited little from the vast expenditure of money and occasional loss of life. In 1855 the "Advance," under the command of Dr. Kane, made a second voyage to the Arctic Seas, but beyond a delightful narrative, as fascinating in style as it was graphic in description, which the accomplished explorer left behind him, the voyage was productive of little real benefit to the scanty fund of knowledge regarding the mysteries which surround the earth's apex.

In 1850-1 Captain McClure, sailing eastward through Behrings Straits, demonstrated the fact of a northwest passage, and although compelled to abandon his vessel, succeeded in passing through to Baffin's Bay with his crew—they being the first explorers that ever passed from ocean to ocean. In 1871, Capt. Hall, who had previously made several Arctic voyages, and had lived amongst the Esquimaux for several years, and become thoroughly acquainted with their language and customs, sailed in the steamer "Polaris," determined to unravel the mystery of the open Polar Sea, in the existence of which he was a firm believer. So sanguine was he of success that a short time before his departure he stated in a public address, delivered before the Chamber of Commerce in his native city, Cincinnati, that, acclimated as he was to the Arctic winter, he felt no hesitation about going back again, and that he proposed to plant his foot upon the North Pole before he died. Capt. Hall succeeded in reaching the highest latitude ever attained with his vessel—viz: 82° 16′, while with a sledge party he went as far north as 84°, or within 360 miles of the goal of his heart's desire.

Unfortunately, however, he fell a victim to dissensions among his own crew, and died under circumstances which gave rise to the rumor that he had been poisoned. After the death of Capt. Hall, and the consequent failure of the Polaris expedition, the American people have taken little interest in Arctic exploration.

In 1873 the Navy Department, incited by popular inquiry as to the fate of the Polaris, decided to send a vessel to the Greenland coast in search of her, or if she was lost, to obtain tidings of her survivors. The United States steamer Juniata was selected for the purpose, Commander Braine, U. S. N., was in command, and Lieut. Geo. W. De Long was on board as Lieutenant and navigator. The Juniata sailed from New York in June, 1873, and proceded as far north as Upernavik, the most northerly settlement of Greenland. Beyond this point, which was reached in August, it was not deemed safe to proceed with the steamer. After a brief consultation it was decided to fit out the steam launch and send her into the recesses of Melville Bay, to discover, if possible, some traces of the missing vessel or her crew. The launch, which, since that voyage, is known as the Little Juniata, was thirty-two feet two inches in length, over all; eight feet four inches beam, and four feet eight inches deep. She was rigged with one mast and a jib and mainsail, and her propeller was so guarded by an iron framework that little danger was to be feared from contact with floating ice. At his urgent request, Lieut. De Long was placed in command, with the following as a volunteer crew: Lieut. C. W. Chipp, present executive officer of the Jeannette; Ensign Sidney H. May, H. W. Dodge, ice pilot; Francis Hamilton, machinist; Wm. King, fireman; Street and Meagher, seamen, and a New York *Herald* correspondent. To their number was added an Esquimaux pilot.

The Little Juniata steamed boldly away from the parent ship on the morning of the 31st of August, with coal for fifteen days and provisions for sixty days in case of emergency, but the orders of Commander Braine to Lieut. De Long were not to extend the voyage beyond eight, or at the utmost ten days. After a most dangerous and profitless exploration they returned to the Juniata in safety after an absence of eleven days. Lieut. De Long desired to make another attempt, but Commander Braine did not consider the facilities at hand sufficient to warrant the undertaking, and so declined to grant his request.

From their cruise in the Little Juniata, Lieut. De Long may be said to have imbibed his love for Arctic adventure. Soon after his return to New York he was thrown into the society of Mr. James Gordon-Bennett, proprietor of the *Herald*. Stanley had just succeeded in penetrating the wilds of Africa and meeting with Dr. Livingstone, had astonished the world by showing what the enterprise of a private individual can accomplish when backed by capital and brains.

De Long felt an ardent longing to distinguish himself by rendering similar services to science, and urged upon Mr. Bennett the undertaking. After repeated consultations, during which the cost of the expedition and its probable results were freely debated, Mr. Bennett finally told Lieut. De Long to go ahead; purchase a vessel, provision her and make an attempt to find the North Pole.

While this consultation was going on, Lieut. De Long made a trip to New Bedford, where he passed several weeks in the society of the whaling captains who are to be found there in large numbers. From conversation with them he was convinced that the Behring's Straits route was the "Down Hill" route and determined to try it. The more he studied over it and examined the charts as to the winds and currents, the more he was convinced that the whalemen were right. He imparted to Mr. Bennett the result of his conclusion, and it was decided to try it. After examining a large number of vessels, it was finally agreed to purchase the Pandora, which was lying in the dock at London at the time, having but lately returned from a cruise to the Arctic, which proved barren of results.

An act was passed by Congress allowing Pandora's name to be changed to Jeannette—in honor of Mrs. Bennett's only sister—to be enrolled as an American vessel, and to be officered by officers of the American navy, Lieut. De Long and the officers under him being assigned to duty on her for the purpose of the expedition.

All the expenses of every kind and nature have, however, been borne by Mr. Bennett, and when she sailed, she left our shores as a national expedition, as that gentleman desired his country to reap the honor of discovery, and has at all times discouraged the association of his name with the expedition, desiring it to be known only as "The American Arctic Expedition."

The Jeannette was a bark-rigged screw steamer of four hundred and twenty tons burden, and eighty-horse power nominal. She was built at the Pembroke Dock Yard in England, in 1864, and designed for a naval dispatch boat. She was subsequently sold to Sir Allen Young. She made three voyages to the Arctic. First to King William's Land in 1873, again to King William's Land in 1874, and the third time to carry mails to the Alert at Peel's Sound in 1875. She was built of Dantzic oak, and was especially strong in the hull. She had a sharp, wedge-shaped floor, which, in case she was "nipped," was to lift her on the ice, instead of allowing her to be crushed between the floes. Her bow was filled in solid, and was protected on the outside by thick iron straps, to protect her timbers when cutting a channel through the ice. She was extra planked on her bottom and bilges, and her frames and beams were of heavy timber. Her hull was further strengthened while she was at Mare Island, three double-trusses and hanging-knees, each beam ten by twelve inches, with a large stanchion in the center, being put in.

In addition to arms, food, cooking apparatus and clothing, the expedition was especially well provided with scientific instruments, and there was every reason to believe that the world would be greatly enriched by the stock of knowledge with which it would return. A complete set of photographic apparatus was taken, together with thirty dozen dry plates for views. There was a portable observatory and a large-sized telescope for taking astronomical observations. Whenever a landing was effected experiments was made with a pendulum and the vibrations noted, so that when the pole was approached the degree of flatness of the earth's surface would be detected. Accurate surveys of all lands were

made and soundings taken of all harbors. Two hundred miles of telegraph wire were placed on board and constant telephonic communication was to be kept up with parties on shore at a distance from the ship. Last, but not least, the expedition was provided with an electric light of immense power, presented by Edison. Mr. Collins, the scientist of the expedition, gave a good deal of attention to the study of the winds and currents and hoped to be enabled on his return, as the result of his observation, to solve some knotty problems which have heretofore perplexed our meteorologists.

The Jeannette had on board thirty-three souls—twenty-five forward and eight aft. The commander, George W. DeLong, was a man a little above the medium height, well-built, active in his movements, and thirty-five years of age. He was born in New York City, and graduated at the Naval Academy in 1865. He was married, his wife being a daughter of Capt. James A. Wotten, an old steamship commander and formerly superintendent and part owner of the famous New York and Havre Line of Steamships. Mrs. DeLong accompanied her husband in the Jeannette from Havre to San Francisco, a voyage which lasted 165 days, and afterward in a trip overland to New York and back to San Francisco.

Lieut. Charles W. Chipp, U. S N., the executive officer of the Jeannette, was born in Kingston, N. Y.; thirty years of age and unmarried. He was with Capt. DeLong in the Little Juniata.

Lieut. John W. Danenhauer, U. S. N., was the navigator of the expedition. He was born in Chicago, Ill.; thirty years of age and unmarried.

Passed Assistant Surgeon James M. M Ambler, U. S. N , was the surgeon. He was born in Fauquier County, Va.; thirty-one years of age and unmarried.

Chief Engineer George W. Melville, U. S N., the engineer of the Jeannette, was born in New York City, 1841. He has a wife and three children living in New York.

Jerome J. Collins, the scientist of the expedition, was a native of Ireland and thirty-eight years of age. He is an accomplished engineer, and thoroughly versed in astronomy, botany and the kindred sciences; unmarried.

Raymond L. Newcomb was a native of Salem, Mass.; twenty-nine years of age and unmarried. He was the naturalist and taxidermist of the expedition.

William Dunbar, the ice-pilot, was a native of New London, Conn., and forty-five years age.

The Jeannette left San Francisco July 8, 1879. She was heard of twice through the *Herald* correspondent on board, who wrote long and interesting letters from Illiolionk Station, in the harbor of Oonalaska, and St. Lawrence Bay, detailing the doings of the party up to August 27th of that year. In 1880, according to Danish authority, a steamer's smoke was seen near the mouth of the Lena River by the Yakuts living there, but in the transmission of this story from tribe to tribe, from the mouth of the Lena west to the Kara Sea, where the walrus hunters heard it, it was no doubt somewhat changed. Nothing further was heard of the Jeannette for a year and a half, but no grave apprehensions were entertained until the spring of last year. Then there began to be much anxiety,

and finally a bill was presented and passed Congress for the fitting out of an Arctic expedition in search of the Jeannette. The Rogers was purchased and started out last summer in its search. Its plan was to proceed along the coast of Siberia, which was a correct theory, but recent dispatches give information of her destruction by fire. Five other expeditions have attempted to gain some information concerning the Jeannette, but without success. They were fitted out by private persons and had other objects as well as searching for the Jeannette.

It appears that the Jeannette, after passing through Behring Strait, took a northeasterly course, passing through an unexplored region.

Several letters from different members of the party have been published but none differ from the official report of Chief Engineer Melville, except in minor points. He says: "We arrived in the Harbor of Lutke, Bay of St. Lawrence on the 25th day of August, and on the 27th completed our supply of stores from the schooner and sailed for the Arctic Ocean, to visit Koliutschin Bay to search for Nordenskiold, and then to continue our voyage of discovery. We arrived at Koliutschin Bay on August 31st, and having found satisfactory proof of the safety of Nordenskiold we continued our voyage to the northward.

"On September 3rd came up with the ice and on the 4th sighted Herald Island. Continued to work through the ice until the 6th day of September when we became firmly fixed in the ice. On September 13th an attempt was made to land on Herald Island, but it was unsuccessful, and the traveling party returned to the ship on the 14th. We continued to drift with the ice toward the northwest, and on October 21st sighted Wrangell Land, bearing south. We continued fast in close packed ice until November 25th, when, after several days severe crushing of the ice and nipping of the ship, she was forced into open water and drifted northwest without control until the evening of the same day, when we brought up against a solid floe piece and made fast, where we again froze in and remained until the vessel was eventually destroyed.

"Long and dreary months of close confinement to the ship and anxiety for her safety continued until May 17, 1881, when we were enlivened by our first sight of land since March, 1880, when we lost sight of Wrangell Land, and as no land was laid down in any chart in our possession, we concluded it to be a new island. This island was seen when we were in latitude 76° 43′ 20″ north, longitude 161° east. The island was named Jeannette Island, though not landed upon. Its position was latitude 76° 47′ north, longitude 158° 56′ east.

The ship and ice continued to drift to the west and northwest, the whole ice field being broken up in all directions. On the night of June 10th several severe shocks were felt and the ship was found to have raised several inches in her bed. There was evidence of an approaching break-up of our friendly floe piece. At ten minutes past twelve A. M., June 11th, the ice suddenly opened alongside the ship, completely freeing her, and she floated on an even keel for the first time in many months.

"The ice continued in motion, but no serious injury occurred to the ship until the morning of the 12th, when the ice commenced to pack together, bring-

ing a tremendous strain on the ship, heeling her over to starboard and forcing the deck seams open. This continued during the day at intervals until evening, when it was evident the ship cou'd not much longer hold together. The boats were lowered on the ice, and provisions, arms, tents, alcohol, sledges and al necessary equipment for a retreat securely placed on the floe. By 6 P. M. the ship had entirely filled with water and lay-over at an angle of about twenty-two degrees being kept from sinking by the opposing edges of the floe. On the morning of the 13th day of June, about 4 o'clock, the ice opened and the ship went down with colors flying at the masthead. Latitude 77° 15′ north, longitude 157° east.

"We remained six days on the ice organizing our system and the line of march south, during which time we had resumed a rapid drift to the northwest. On June 24th having marched south one week and obtained observations for position, we found we had drifted to latitude 74° 32′ north, a loss of twenty-four miles northwest.

"We continued our march south and west and finally landed on Bennett Island July 29th. Hoisted the national flag and took possession of the island. It is located in north latitude 76° 38′, east longitude 150° 30′. We traversed the eastern end of the island.

"Left it August 6th, and sighted the north side of Thaddeus (Faddeyev) Island, one of the New Siberia group, and remained there ten days ice bound. Landed on the south side of Thaddeus Island August 31st. Left south end of Kotelnoi Island September 6th. Camped in sight of Stolhoi Island September 7th. Landed on Simonaski Island September 10th.

"We left for Barkin, at the Lena's mouth, September 12th. Separated by a gale of wind the same night."

The list of people in the boats as follows.

First Cutter.—Lieutenant DeLong, Dr. Ambler, Jerome J. Collins, William Nindeman, Louis Norris, Hans Erikson, Henry Knack, Adolf Bressler, Carl Gortz, Walter Lee, Neils Ivorson, George Boyd, Alexia, Ah Lorn.

Second Cutter.—Lieutenant Chipp, Captain Dunbar, Alfred Sweetman, Henry Waxen, Peter Johnson, Edward Star, Shawell, Albert Kaihne.

Whale Boat.—Engineer Melville, Lieutenant Danenhauer, Jack Cole, James Bartlett, Raymond Newcomb, Herbert Leach, George Landentach, Henry Wilson, Manson, Aniquin, Long.

Fifty miles from the mouth of the Lena they lost sight of each other during a violent gale and dense fog. Boat No. 3, under command of Engineer Melville, reached the eastern mouth of the Lena on the 29th day of September, and was stopped by icebergs near the hamlet of Idolaciro-Idolatre on the 29th day of October. There also arrived at Bolonenga boat No. 1, with the sailors, Nindeman and Norris. They brought the information that Lieutenant DeLong, Dr. Ambler, and a dozen other survivors, had landed at the northern mouth of the Lena, where they were in a most distressing state, many having their limbs frozen.

Lieut. Danenhauer, who was in the Melville party, says in one of his letters

that they had to travel 700 miles over the ice from the ship to the mouth of the Lena. They landed in shoal water and were compelled to wade two miles to land. They were forced to travel 100 miles further before they reached shelter, and he says he was up five days and four nights without sleep or rest. He also gives the following points of scientific interest:

"The result of the drift for the first five months was forty miles. There was a cycloidal movement of the ice. The drift for the last six months was very rapid, and soundings pretty even. There were eighteen fathoms near Wrangell Land, which was often visible seventy-five miles distant. The greatest depth found was eighty fathoms, and the average thirty-five; the bottom, blue mud. Shrimps and plenty of algological specimens were brought from the bottom. The surface of the water had a temperature of 20° above zero. The extremes of temperature of air were: greatest cold, 58° below zero, and greatest heat 44° above zero. The first winter mean temperature was 33° below zero; the second winter 39° below zero. The first summer the mean temperature was 40° above zero. The heaviest gale showed a velocity about fifty miles an hour; such gales were not frequent. Barometric and thermometric fluctuations not great. There were disturbances of the needle coincident with auroras. Winter growth of ice eight feet; heaviest ice seen, twenty-three feet. Engineer Schock's heavy truss saved the ship on November 21st from being crushed. Telephone wires were broken by a movement of the ice. The photographic collection was lost with the ship. Lieut. Chipp's 2,000 auroral observations were also lost. The naturalist's notes were saved. Jeannette Island was discovered May 16th, in latitude 76° 47′ north, and longitude 158° 56′ east. It was small and rocky, and we did not visit it. Henrietta Island was discovered and visited May 24th, latitude 77° 8′ north, longitude 157° 32′ east. It is an extensive island. Animals scarce; glaciers plenty. Bennett Island lies in latitude 76° 37′ north, longitude 148° 20′ east. It is very large. On it we found many birds, old horns, driftwood and coal, but no seal or walrus. A great tidal action was observed. The coast is bold and rocky. The cape on south coast was named Cape Emma. Nothing has been heard from Lieut. Chipp's party. It is more than probable that they are all lost."

As soon as Engineer Melville learned of the landing of Lieut. DeLong he organized a search for the party, turning back to Belun and subsequently to the mouth of the River Lena at the coast. Various records and articles of personal and goveryment property were found. The latest written bulletin by DeLong was delivered to Melville by a Yokut hunter, and was dated October 1, 1881, annoucing his intention to cross to the west side of the Lena and proceed south to the settlements. The party had suffered terribly and had but two days provisions left.

After waiting a day or two for the Lena, upon which they were to pass, to freeze over sufficiently to bear their weight, they crossed it to proceed up the west bank of the stream toward Yakutsk. They hoped to find game for food. The latest information indicates that they entered a wilderness destitute of habita-

tions or game, and soon began to experience the direst hardships. Quite likely they have all perished long before this—a sad reduplication of the fate of Sir John Franklin and his command, under almost the same circumstances, on the American instead of the Asiatic continent.

In the meantime the Russian Government has taken an active interest in the matter. M. Siberiakoff, himself an experienced arctic explorer, has tendered the use of his vessel, the Lena. James Gordon Bennett has ordered and provided means for the most energetic efforts and our own Government has sent out Lieut. Harber and Master Scheutze of the U. S. Navy, both of whom have arrived before this time at Irkutzk, to assist in the search. If Lieut. DeLong has been found and is in condition to do so, he will take command of the new expedition, otherwise, Lieut. Harber, who is next in rank, will assume command. Engineer Melville in his official dispatches assumes a cheerful tone and says that he has every reason to hope to find DeLong and his party, but in his private letters to his wife he holds out no hope whatever.

There is hardly a possibility that one of the wanderers will be found alive. As late as the middle of January, DeLong's party, which had been lost in a wilderness for many weeks, was still untraced. Only by a miracle can any of its members have survived the winter. It is not unlikely that the searchers will come across successive graves, and a last unburied body, but even this satisfaction may fail to be attained. There is less probability that the fate of Chipp's company will ever be known.*

WEST INDIAN GEOGRAPHICAL NOTES.

BY CAPTAIN E. L. BERTHOUD.

Mr. Alphonso Pirrard, a French savan in a late trip in the West Indies, has visited Saint Domingo. Here he ascertained that the remains of Christopher Columbus discovered in the cathedral in 1877, are the true remains; and that the bones transported to the Havana in 1755 are not those of the celebrated navigator, but are those of his grandson, which were lying in a contiguous vault.

After some interesting researches at Samana Bay, which furnished him a skull and the incomplete skeleton of one of the aboriginal inhabitants of Hayti, he also found a series of Indian inscriptions in the grottoes of the coast.

Proceeding to the Havana, Mr. Pirrard found in the Archives of Cuba, several articles of high interest, elucidating the geographical discoveries of the last century in the range of the Rocky Mountains. One of these is the journal of the French Canadian Jacques L' Eglise, who discovered the sources of the Missouri, and who relates that a short distance west of the head waters of the Missouri another stream took its origin, which from the account of the Indians finally empties into the Pacific Ocean.—[*Translated from l' Exploration.*]

* Dispatches just received from Melville announce the finding of DeLong and party, all dead, at the Lena Delta, about March 24th. His books and papers were all found.—[ED. REVIEW.

NOTE BY TRANSLATOR.—We think that L' Eglise undoubtedly alluded to the Reynolds and Henry Passes of the Rocky Mountains, where the head sources of Jefferson and Madison Forks are not over one and one-half miles from Henry's Lake, the main head of Lewis' Fork of the Columbia. I have surveyed and examined that locality personally.

MINING AND METALLURGY.

A LOW-GRADE STAMP MILL.

MRS. FLORA ELLICE STEVENS.

The low grade ores are distinguished from those of the higher class, as in the former instance there is less of the precious metals to the quantity of ore than in the latter, and consequently the method of treating the low, or poor grade must be different from that acceptably employed for the richer mineral; for it is far too expensive to use the same means of treatment with that running fifteen or twenty ounces to the ton, as would pay well in the ore running several hundreds. Of course it must be remembered, that I am speaking of silver ores, as the barest trace of gold will always pay for working.

But in a general silver region, particularly where the ore is found in the level ground, instead of among the mountains, there are a great many claims, which would pay well if they were worked by an inexpensive method of treatment. A stamp mill built to meet this exigency, I had the pleasure of visiting, a description of which I will endeavor to give, though it will necessarily be less full and complete than I would desire, as it has been a year since I examined the mill, and most of my notes made at the time have been lost.

The mill is built upon the side of the hill, as by this means an advantage will be gained in the distance the ore cars are to be raised. About five hundred yards away is the mine. A tramway, perhaps a foot and a half wide, connects the two, along which iron cars carry the ore, drawn by horses *a la tandem*. The cars run directly on to the elevator, and are hoisted to the ore or quartz house, which is the very highest division of the mill. This room is 16 by 75 feet.

The ore is "dumped" over iron screens, the fine ore dropping down to the bins, and the coarse ore falling on to the breakers, just above these, for crushing. The breakers in this mill were Blake's improved, with a capacity of a 100 tons per day. As the next step, the ore is taken from the chutes to the self-feeders, which are fed automatically by the dropping of the battery. The battery room is 36 by 75 feet, and the building increases in width as we go down in about the same ratio, to make room for the machinery, which now becomes necessary.

This battery is a knee battery of forty stamps, makes ninety-five drops per minute, and is capable of crushing 124 tons every twenty-four hours.

From the battery the sand, as it has now become, is run into settling sand tanks, there settled, and shuffled into pans for amalgamating.

These pans, often erroneously called tubs, are placed in rows, in what is known as the pan room. There were in this instance twenty combination amalgamating pans employed, of two tons capacity to the change; and with ten settlers capacity for the pans. From the settler bowls quicksilver is taken in pipes to the strainers; from the strainer safes, again in pipes to the reservoir of the quicksilver elevators, and to the pan floor into another receiver. From this it is taken in pipes to the bowls on the pans. Down from these bowls the quicksilver is let by charges into the pans, as needed to charge them—these contain the ore now reduced to a fine mass—for amalgamating

The ore, now called amalgam, is ready for retorting. After retorting the crude bullion is hauled on to an iron plate, broken up, put into crucibles, and smelted into bars, generally a foot and a half long, and eight inches thick. All that remains is to ship it to the mints.

In the mill visited the engine was 24 by 48 inches, of 250 horse power, the main belt thirty-six inches in width, while the main driving pulley of the fly-wheel had a capacity of 39,000 pounds. The boilers, four in number, were fifty-six inches by sixteen feet in diameter, of 250 horse power capacity. This is what termed the "wet" process, as the roasting does not do for poor grade ores. In the mill described, ores have been worked for less than $5 per ton.

Were I a practical miner, I would be able to enlarge upon these details, and give them with more force and clearness than I have done. As I am not, I may only submit them as the skeleton of a description, trusting that those who read it, may gain from it a slight idea of a model low-grade stamp mill.

MINING PROSPECTS IN COLORADO FOR 1882.

From an average production of only three or four millions, Colorado has suddenly risen to the first rank as a producer of the precious metals among the States and Territories for gold and silver combined; as for silver alone, it ranks first, while for gold it holds the fourth rank. In the relation of production to area, it holds the first rank, likewise, for gold and silver combined and for silver alone, and the third for gold alone. In the relation of production to population, however, it ranks only third for gold and silver together, second for silver alone, and sixth for gold alone. The total value of its product during the census year in gold and silver was, in round numbers, nineteen and a quarter million dollars, and if we add to this the value of lead and copper in crude metal produced, we have a total value of metallic product of twenty-two and three quarters million dollars.

From all sections of the State, reports received indicate that the coming season will be the liveliest in mining operations ever recorded in the history of Colorado. Not only are the Leadville and other mining districts flourishing, but, throughout the State, innumerable small camps are springing up, many of which, it is expected, will be heard from before the end of the year. Of course, active mining operations, in many places, will be retarded for a time yet by snow; but preparations are making to resume work as soon as the weather will permit, on claims that have long lain idle.

CLEAR CREEK COUNTY.

At Dumont, the Albro mine is shipping ore to the smelting-works at Golden. The Unadilla Company is taking the average quantity of ore from the Eagle mine, and is actively engaged in developing the mine by running levels and cross-cuts, and in sinking the main shaft. A drift running on the vein from the cross-cut in the Syndicate mine is in 124 feet, and exposes a vein about eighteen inches thick of solid ore upon the hanging-wall.

At Montezuma, the Silver King concentrator is running steadily, working about five tons per day. The Silver King mine is reported as looking excellent, and is employing a force of twenty men. Connection was recently made between the first and second levels, by a winze. The Little Helen Mining Company is driving a cross-cut tunnel to the Hidden Treasure lode. The various mines of less importance in the vicinity of Montezuma are reported as looking very well.

According to the census reports, this county produced during the year ending May 31, 1880, $376,041 in gold and $1,954,547 in silver, assay value.

GILPIN COUNTY.

The mill of the California Mining Company at Black Hawk will start up in a short time on ore from the California mine. The mine is yielding a fair amount of mill-dirt and smelting ore. A good body of ore was recently encountered in driving the 150-foot level of the Mountain City, west from the working-shaft. Twenty-five stamps of the New York mill are dropping on ore from the United Gregory lode. The other fifty stamps are working ore from the Cotton and other lodes. The Quartz Hill Company is meeting with fair success in the development of its mine, and expects in a short time to have the mill running.

The more prominent mines in the vicinity of Central City continue as at last report, and the mills are kept busy crushing the product. The California Consolidated Mining Company, which recently purchased the Standley-California mine, has begun work on the mine, and expects to have the fifty-stamp mill in operation in a few weeks.

Production for the census year $2,012,134 in gold, $674,727 in silver.

THE SAN JUAN REGION.

The San Juan region has always been understood to comprise Ouray, Dolores, Hinsdale, La Plata, San Juan and Rio Grande, and in it are the well-

known rich mining districts, having each its own particular town or outlet as follows: Ouray, having the Sneffels, Uncompahgre, Bear Creek, Red Mountain Gulch and Poughkeepsie Gulch mines tributary to it; Lake City, having the rich mines of Hensen Creek, Engineer Mountain, and a large number immediately around the town itself; San Miguel, having the celebrated gold and silver mines of Marshall Basin, Ingram Basin, Bear Creek, Turkey Creek and twenty miles of placer claims on the San Miguel River; Ophir, having its own rich mines all around it; Rico, being the center of all the mines of Dolores County, and having an outlet by the Denver & Rio Grande Railroad near Durango, and at a distance of about twenty-eight miles. With the exception of the latter, all these are tributaries to the main line of the Denver & Rio Grande Railroad. Silverton has tributary to some remarkably good mines immediately around the town, and those of Cunningham Gulch, Eureka Gulch and Animas Forks, and has its outlet, as aforesaid, by the Denver & Rio Grande Railroad, now under construction from Durango to Silverton. Production for this region in 1880, $891,042.

JEFFERSON COUNTY.

The smelting-works at Golden are worked to their full capacity. The mines of Gilpin and Clear Creek Counties are sending them large quantities of ore, and there is received from the Robert E. Lee mine, of Leadville, one car of ore per day, which yields from $100 to $600 per ton.

LAKE COUNTY.

The mines in and around Leadville continue in the flourishing condition noted for some time past. The roads which at this season of the year are generally impassable on account of the melting snow, are reported in excellent shape, and the large shipments from the mines are maintained.

The report of the smelters for the quarter ended March 31st is a gratifying one, showing the aggregate product to have been $4,031,433, as against $3,097,820 for the same last year—an increase of nearly one million dollars thus far this year. This shipment is the largest ever made by the mines during the same length of time; and as the smelters have large quantities of ore on hand, and the mines are increasing their output, it may be taken as an indication that the product of the Leadville mines for 1882 will largely exceed that of any previous year. The mines are in good condition, and the shipments large and steady.

One of the most convincing indications of Leadville's prosperity is the large stocks on hand at the smelters, which, although working to their utmost capacity, can not treat all the ore they receive, and are accumulating large quantities in their bins and yards. The mines of Fryer Hill continue to be the leading features of interest, though there is a large increase in the output of the Carbonate Hill mines. Production for the census year, $82,687 in gold, $13,226,999 in silver.

PITKIN COUNTY.

This is a new county, lying westwardly from and adjoining Lake County. Its county-seat is Aspen, some thirty-five miles from Leadville. Among its best known mining camps is the Independence District where gold is the most abundant metal. The Farwell Consolidation with the well-known J. V. Farwell, of Chicago, at its head is in the lead of all, and so rich are its mines and well managed its affairs that its five dollar shares are said to be in demand at eighty dollars each. Their mines have netted about $40,000 per month, for the past three months.

The Independence mine, the Last Dollar, the Choler, Mammoth, Dolly Varden, Lincoln, Pacific and Sheba, the Minnie, Legal Tender, Bennington and Climax, are all now the property of the Farwell Company, besides the valuable properties known as the Tam O'Shanter and Brown tunnel sites. The former is now in 170 feet and the latter 500 feet. This large array of valuable mines does not comprise all the property of the company, however. The Johnson placer and many others, which are not fully developed, are owned by the company.

A good idea can be had of the extent and importance of the developments on these claims by starting from the Minnie's workings. At this mine a tunnel has been run in about thirty feet to strike the vein. The mineral varies from a foot to two feet in thickness, and is composed of honeycombed quartz, interpersed with iron and copper pyrites. Rich specimens of free gold are often encountered in these workings. The outcrop of the vein is about sixty feet above where the vein has been cut.

Many other good mines have been opened and are now being worked in this district, among which are the Lake George and Sunrise: also those of the Hamilton Mining Company. August Schott, an old prospector and experienced miner, writes as follows:

"I have just returned from a trip over the county picking up such knowledge as is necessary for my business. There is a great rush for the lower end of this county, but the snow is so deep that no prospecting can be done by strangers. The first hoisting engine has arrived in the gulch. It is for the Minnehaha mine, a claim situated between the Farwell property and that of the Hamilton Company, and joining both. There is a large body of mineral there, but it lies deep. A seventy-five foot shaft has failed to reach it, but the boys are determined to go down to it."

"Four men have been working all winter on the Mt. Hope mine, driving a tunnel to cut the vein. At the intersection it was only six inches thick, but it soon widened to six feet solid qnartz, which yielded $25 in gold per ton under the stamps, while the tailings are worth $5 per ton. The great cry is 'a custom mill' and this will be the leading gold camp in Colorado."

THE PRECIOUS METALS.

The Census Bureau has engaged Mr. Clarence King, who was recently at the head of the scientific survey, to collect the statistics of the production of the precious metals. Mr. King is well fitted for this work by his former studies and investigations, and has made a valuable report. The following table shows the aggregate production of the precious metals for the year ending March 31, 1880:

	Deep Mines.	Placer Mines.
Alabama	$ 1,301	. . . . .
Alaska	. . . . .	$ 6,002
Arizona	2,507,534	30,256
California	9,652,575	8,649,253
Colorado	19,146,066	103,106
Dakota	3,325,547	51,109
Georgia	14,166	67,195
Idaho	1,049,510	894,684
Maine	10,199	. . . . .
Michigan	25,858	. . . . .
Montana	3,539,730	1,171,105
Nevada	17,268,482	50,427
New Hampshire	26,999	. . . . .
New Mexico	441,691	. . . . .
North Carolina	114,367	4,726
Oregon	190,172	934,522
South Carolina	6,499	6,597
Tennessee	1,998	. . . .
Utah	5,014,503	20,171
Virginia	9,321	. . . . .
Washington	16,800	120,019
Wyoming	17,321	. . . . .
Total	$62,381,448	$12,109,172

ALL MINES.

	Gold.	Silver.
Alabama	$ 1,301	. . . . .
Alaska	5,951	51
Arizona	211,965	2,325,825
California	17,150,941	1,150,887
Colorado	2,699,898	16,549,274
Dakota	3,305,843	70,818
Georgia	81,029	332
Idaho	1,479,653	464,530

Maine	2,999	7,200
Michigan		25,858
Montana	1,805,767	2,905,068
Nevada	4,888,242	12,430,667
New Hampshire	10,999	16,000
New Mexico	49,354	392,337
North Carolina	113,953	140
Oregon	1,097,701	27,793
South Carolina	13,040	56
Tennessee	1,998	
Utah	291,587	4,743,087
Virginia	9,321	
Washington	135,800	1,019
Wyoming	17,321	
Total	$33,379,663	$41,110,957

It will be seen by this table that California produces in value a little more gold than Colorado does of Silver. The deep mines in California, particularly in the Bodie district, have produced more gold than the auriferous gravel which seems to be fast becoming exhausted. The Nevada mines, which produced such quantities of precious metals from 1871 to 1879, show a notable falling off, due in large part to the diminution of the Comstock lode. Nevada also lacks water to work her gravel deposits. The Utah mines give a very steady production of the precious metals. The mines of Arizona are of recent development, and full statistics have not been collected. There are large mining regions in Alaska, New Mexico, Idaho, Montana, Dakota and Washington Territory that have hardly yet been examined.

The total production of gold and silver for the year 1880 was about $74,500,000, while the out-put in 1881 was nearly $77,000,000. It is a noticeable feature in mining operations that the production of gold mines in this country and other lands is gradually falling off, indicating that gold mines are becoming exhausted.

There may still be rich gold fields in the northern part of the North American Continent as indicated by the glaciers which have dropped gold all along their course in Indiana and other States. Prospecting for the precious metals ought not to be left entirely to private enterprise, but it could be incorporated in the scientific survey, and thus be fostered by the government. Great losses are often entailed by individuals and companies which a little scientific knowledge would have prevented. Every government certainly has the right to develop its natural resources.—*Kansas City Journal.*

THE PRODUCT OF GOLD AND SILVER FOR 385 YEARS.

Dr. Adolph Soetbeer publishes a report upon the precious metals, taking the year 1493 as the starting date in his computations, claiming that the modern history of gold and silver begins with the return of Columbus from his first voyage to the New World. Towards the end of the fifteenth century, before the treasures of America were unlocked, the supply of the precious metals in civilized countries had fallen far below the requirements of trade. Mr. Jacobs' conjecture in regard to the specie which was available for the exchanges of Europe in 1492, rates the total sum at no more than $165,000,000. Since then the mines of the world have furnished over fourteen and a half billions in silver and gold. We present below a valuation of the weights tabulated by Dr. Soetbeer, for three hundred and eighty-two years, from 1493 to 1875, supplemented by an estimate of the production for the three years 1875 to 1878, uncovered by his table:

	Production of precious metals from 1493 to 1878.
Gold	$6,612,193,087
Silver	7,976,429,920
Total	$14,588,623,007

We desire at present to direct attention to the steady increase in the supply of the precious metals from century to century, and especially to the enormous figures of the gold production during the last twenty-eight years. That the position may be seen at a glance, we have prepared tables of the annual average supply for each of the precious metals by decades or double-decades from 1493 to the end of last year. The production of each century is summarized and averaged by itself. Our readers will do well to preserve the tables for reference. Average annual production:

SIXTEENTH CENTURY.

Years.	Gold.	Silver.
1493 to 1520	$3,856,578	$ 2,015,125
1521 to 1544	4,758,536	3,867,325
1545 to 1560	5,655,746	13,359,850
1561 to 1580	4,545,864	12,841,062
1581 to 1600	4,904,748	17,960,337

The total production in the one hundred and eight years, from 1493 to 1600, amounted to $501,693,248 gold, an average of $4,645,307 per annum; and $976,024,900 in silver, an average of $9,065,045.

SEVENTEENTH CENTURY.

Years.	Gold.	Silver
1601 to 1620	$5,662,392	$18,134,837
1621 to 1640	5,516,180	16,875,600
1641 to 1660	4,828,542	15,705,112
1661 to 1680	6,154,196	14,448,875
1681 to 1700	7,154,419	14,658,962

The total production in the one hundred years, from 1601 to 1700, amounted to $606,314,580 gold, an average of $6,063,145 per annum; and $1,596,407,750 silver, an average of $15,964,077.

EIGHTEENTH CENTURY.

Years.	Gold.	Silver.
1701 to 1720	$ 8,520.172	$15,246,350
1721 to 1740	12,680,568	18,487,700
1741 to 1760	16,355,806	22,858,591
1761 to 1780	13,760,543	27,986,227
1781 to 1800	11,823,234	27,689,697

In the hundred years, 1701 to 1800, the production aggregated $1,262,806,400 gold, an average of $12,628,064; and $2,445 371,337 silver, an average of $24,154,713.

NINETEENTH CENTURY.

Years.	Gold.	Silver.
1801 to 1810	$ 11,815,258	$38,336,681
1811 to 1820	7,606,347	23,185,513
1821 to 1830	9,447·953	19,746,510
1831 to 1840	13,484,069	25,572,793
1841 to 1850	36,392,831	33,460,293
1851 to 1860	134,107,307	38,396,813
1861 to 1870	125,284,742	52,312,537
1871 to 1878	112,081,628	82,400,000

In the seventy-eight years, 1801 to 1878, the production aggregated $4,278,938,135 gold, an average of $54,846,642 per annum; and $2,969,306,913 silver, an average of $38,068,037 per annum.

BOOK NOTICES.

A HISTORY OF THE ST. LOUIS BRIDGE. By C. M. Woodward, Professor of Mathematics and Applied Mechanics, and Dean of the Polytechnic School of Washington University. 4to, pp 400. Illustrated. G. I. Jones & Co., St. Louis, Publishers.

Long before the St. Louis Bridge was completed, Captain Eads, its illustrious builder, closed a report to the Board of Directors with the following statement: "When all of the many difficulties that have retarded this great work shall have at last been surmounted and the Bridge becomes an accomplished fact, it will be found unequaled in the important qualities of strength, durability, capacity and magnitude by any similar structure in the world."

That the bridge has become an accomplished fact and stands without a rival in the world everybody knows; but of the difficulties upon whose solution the success of the bridge as a work of engineering depended, there is very little knowledge. Doubtless in every great work new questions come up which have never before presented themselves for practical answers; but it is doubtful if any other work transcended experience at so many points. Of all these difficulties, of the various attempts both successful and unsuccessful to overcome them, and of the construction and erection of the bridge in every detail, Prof. Woodward gives an account which cannot fail to meet the demands both of the professional and non-professional reader; the happy combination of a plain statement of facts with an interesting story of events makes the work altogether *sui generis*. It is complete, clear, concise and entertaining. The book is really much more than a history of the St. Louis Bridge; its principal claim to a high place among books which last for all time is, that it has put together a great mass of experience in engineering work which would otherwise have remained scattered and useless, because inaccessible, and these he has placed in form ready for use by all the world whenever wanted. By a judicious arrangement of subjects and indices, the reader is enabled to find just what he may want without reading over much which he may not want, so that the book must prove invaluable to engineers and scientists as a work of reference. As a record of the planning and erection of a structure which required at times consummate skill both of a head and hand and not unfrequently demanded immediate answers to questions upon which experience was dumb, the book contains many chapters which would be valuable additions to scientific literature if published separately. Some of these are deserving of special mention.

The sinking of the piers was itself a great scientific work. When it is remembered that, owing to the treacherous nature of the river, which at times cours its bed of the sediment which it had deposited years before, the great piers

of masonry had to be sunk to the bed rock of the river, the magnitude of this undertaking, upon which the ultimate success of the entire work depended, will at once appear. The deepest of the piers went down 110 feet below the surface of the water and of this distance more than two-thirds was below the bottom of the river. Caissons of iron were used in sinking the piers, and the weight of the masonry furnished the pressure for sinking the caissons. The special peculiarities consist of the magnitude of the masses of material handled and the number of special devices which the needs of the moment only could suggest. It does not seem probable that any large bridge will in future be built upon piers before its engineer has carefully studied the methods employed in sinking the piers of the St. Louis bridge, and for this reason the value of the chapters devoted to this subject cannot at present be fully estimated.

The sinking of the piers afforded exceptional opportunities not easily reproduced for the study of the "Physiological effects of Compressed Air." Under this title Prof. Woodward gives a *resumé* of the experiences of the men who were employed in in the caisson and an exhaustive discussion of the subject from a scientific standpoint. The explanations here given of phenomena, no doubt observed before, are, so far as we know, quite new and have been endorsed by some of the best physicians in the country.

The special features in the manufacture of materials for the superstructure of the bridge will be well shown by the following quotation from the book itself:

"No sooner were preparations made for the construction of the arches than practical difficulties appeared. It is true many of them had been anticipated, but it is equally true that the difficulties actually met surpassed the shrewdest conjecture. The steel makers found that their facilities were inadequate to the magnitude of the work undertaken; their workmen were unskilled; and their foremen without experience in working steel in such large masses.

"Both iron and steel makers were unaccustomed to the rigid tests required. The insertion into specifications of the items of elastic limit and modulus of elasticity was a new feature in bridge contracts. Moreover, the detail drawings and specifications indicated a grade of workmanship altogether exceptional. To be sure they involved nothing, as regarded accuracy, either impossible or even difficult, but they were unusual and of course expensive. All these things now add to the value and fame of the great work; without them this bridge would be merely one of a thousand bridges, and this history never would have been written; but in 1871, '72 and '73, the fame of the bridge had little weight with a contractor or with a stockholder.

"Most of the real difficulties were actually overcome; and through the influence of Mr. Eads's specifications the standard of good workmanship was raised throughout the world. In the construction of the St. Louis bridge, engineering made progress. Let me quote on this point from so eminent an authority as *London Engineering:* In its issue of October 10, 1873, the editor said: 'Our present requirement being to select some example of the most highly developed type of bridge-building of the present day, we have no difficulty in passing be-

fore ourselves in mental review the different works now in progress thoughout the world, and we have still less difficulty in electing as our example the magnificent arched bridge now almost completed by Capt. Eads, at St. Louis. In that work the alliance between the theorist and the practical man is complete. The highest powers of modern analysis have been called into requisition for the determination of the strains, the resources of the manufacturer have been taxed to the utmost in production of material and perfection of workmanship, and the ingenuity of the builder has been alike taxed to put the unprecedented mass into place. In short, brain power has been called into action in every department. * * *'

Thus wrote the accomplished critic, unmindful for the time of the perplexities of the manufacturer, the misgivings of the contractor, the anxieties of the capitalist, and the trials of the engineer. Each in his place was abundantly exercised. When cross examined before the tribunal of actual work, the steel and iron makers who had given such repeated assurance of their ability to construct all that was required, confessed themselves less confident and sometimes completely at loss, and more than all, after careful study of the drawings and specifications, even when numerous changes had been made with a view to lessening the cost of construction, the contractors claimed that the quality of workmanship required was far beyond their expectation and that on many points Mr. Eads demanded impossibilities. Every detail was sharply discussed, and agreements were reached at the expense of time and generally of money.

A complete account of all these difficulties, and of the ways in which some were overcome and others avoided, makes of these chapters a standard authority on the manufacture of iron and steel in large pieces; in the same way the records of the tests of materials, and methods and machines used in testing, have a value far beyond that of showing the care and precision with which every part of the work was constucted.

The chapter on "The Theory of the Ribbed Arch" is also deserving of special mention; the subject has never been more beautifully and satisfactorily discussed. All the mathematical calculations used are given in detail.

The book is a quarto of nearly 400 pages, and is as well printed as any book we have ever seen. It is illustrated by thirty-nine large plates of drawings, showing accurately every detail of the bridge. The drawings were made by Wm. Gerhardt, of St. Louis, and photo-lithographed by Julius Bien, of New York. They are unsurpassed. There are also eleven artotype plates, made by R. Benecke, of St. Louis, giving excellent views of the bridge in process of erection, and seventy-two diagrams illustrating special points.

The book has received the highest endorsement from professional engineers.

BIRDS-NESTING. By Ernest Ingersoll, 12mo. pp. 110. Salem, Mass., Geo. A. Bates, 1882, $1.00. For sale by the Nauralist's Bureau.

This little volume, made up from a series of articles by the prolific and always entertaining and instructive author, first published in the columns of *Science News*, is intended for a hand book of instruction in gathering and presuming the nests and eggs of birds for the purposes of study.

The topics are Field Work, in which instructions are given for discovering nests, on the habits of birds, naming eggs, etc.; Preparation of Specimens, including descriptions and illustrations of the various implements used; How to construct and arrange the Cabinet; Lists of birds whose nidification is unknown; Bird architecture; the whole concluding with a full index.

To amateur collectors, or even to experts, this book will be found eminently useful, while to the casual reader it will be found to possess much of interest.

JOHN INGLESANT, a Romance. By J. Henry Shorthouse, 12mo. pp. 445: MacMillan & Co., New York, 1882. For sale by M. H. Dickinson, $1.00.

This might just as well be termed a historical novel, but since the author prefers to call it a philosophical romance, the reader may take his choice, but under either title he will find it an unusually attractive story, not only from its historical truthfulness, its skillful management of characters and plot, but also from the strictness with which the philosophical element is kept in view at all times. The author says on this point, "In books where fiction is used only to introduce philosophy, I believe that that it is not to be expected, that human life is to be described simply as such. The characters are, so to speak, sublimated, they are only introduced for a set purpose and having fulfilled this purpose—were it only to speak half a dozen words—they vanish from the stage." If this be his only purpose, he has succeeded admirably in masking his object with an accuracy of description, a selection of important and thrilling events in history and a fascinating style of writing, so that many if not most readers will find the romance *per se* rather than the philosophical lesson the prominent feature.

FIRST LESSONS IN GEOLOGY. By Prof. A. S. Packard, Jr., Brown University. Octavo, pp. 128, illustrated. Providence Lithograph Co., Providence, R. I., 1882.

This is a text book to accompany a series of lithographic charts known as the Chautauqua Scientific Diagrams, Series No. 1. Geology. It is written in a clear and popular style, while Professor Packard's connection with it guarantees its correctness beyond question. The charts are of large size, fairly executed and a very excellent aid to a lecturer or teacher in illustrating his subject. There are ten in number, beginning with the Action of Water, including glaciers, cañons, etc., then the Action of Heat including volcanoes, geysers, earthquakes, etc. America during the silurian, devonian, carboniferous, triassic and jurassic, cre-

taceous, tertiary, pre glacial and glacial periods. They will make a useful addition to our school literature.

THE TRANSACTIONS OF THE ACADEMY OF SCIENCE, OF ST. LOUIS; Vol. IV, No. 2, octavo pp. 394. Published by the Secretary, $2.00.

This handsomely printed volume contains important papers by Dr. G. Seyffarth, Profs. C. V. Riley, F. E. Nipher, C. A. Todd, H. S. Pritchett, Geo. Engelmann and E. A. Engler. We reprint one of these papers in the present issue of the REVIEW, and shall present others to our readers in the future as may seem appropriate.

OTHER PUBLICATIONS RECEIVED.

Commercial Relations of the United States, Nos. 13, 14, 15, from Hon. R. T. Van Horn; Transactions of the Seismological Society of Japan, Vol. II, from Prof. H. M. Paul; Bulletin of the U. S. National Museum, No. 22; Little known Facts about well known Animals, from Prof. C. V. Riley; Medicinal Flora of Kansas, by Robt. J. Brown, Leavenworth, Kansas; Time-Keeping in Paris, by Edmund A. Engler, St. Louis, Mo.; Report of the standing committee on water on the Impurity of the Water Supply of Boston, with the report of Prof. Ira Remsen, on the subject; Directions for Collecting and Preserving Insects, by Prof. A. S. Packard, Jr., M. D.; Retarded Development in Insects, by Prof. C. V. Riley; the Palæolithic Implements of the Valley of the Delaware; What is Anthropology? a lecture by Prof. Otis T. Mason; The 17th Annual Catalogue of Officers and Students of the Massachusetts Institute of Technology, 1881–2; Catalogue of Officers and Students of Marietta College, Ohio, 1881–2; Hints for Painters, Industrial Publication Co., N. Y., 25c; The Silk-Worm, a Manual of Instruction for the Production of Silk, by Prof. C. V. Riley; The Pacific Northwest, Oregon and Washington Territory, from A. L. Maxwell.

SCIENTIFIC MISCELLANY.

SOME RECENT IMPROVEMENTS IN THE MECHANIC ARTS.

BY F. B. BROCK, WASHINGTON, D. C.

AUTOMATIC CASH SYSTEM.

A novel apparatus, designed to take the place of cash-boys in large stores, provides a cash-box, detachably secured to an endless cord by a spring-actuated clamping-lever. The box rests on a grooved track, and is stopped by coming in

contact with projections on the under side of a cover of a trough fixed to the track, into which the cash-box enters. The box is unclamped from the endless cord by a clamping-lever, and a projection on the box bearing against two spring-guides on the under side of the trough cover. Raising the cover of the trough removes the spring-guides and the stops on the trough-cover from the cash-box, which is then engaged with and carried forward by the endless cord.

COMPRESSING AND COOLING AIR.

This novel improvement consists in providing the cylinder of an air-compressor with two independent water-chambers arranged respectively upon the opposite ends or heads of the cylinder, and through which a current of cold water is continually flowing. A third water-chamber surrounds the body of the cylinder. This latter chamber is divided into two compartments, each of which is supplied with cold water near the ends of the cylinder; but they have a common outlet through an annular passage arranged between them.

MAKING BREAD BY MACHINERY.

The bakers' fraternity, realizing the importance of making and baking bread which shall offer serious competition to what is properly called home-made bread, have made quite a number of improvements. It is of importance in bread-making that the fibre of the dough be as nearly continuous as possible on the outside, so that the loaves may appear white and flaky where they break apart, and also to prevent them from drying out too rapidly. In making bread by hand conformity to these conditions is easy. By the use of machinery, however, the dough is cut into loaves by sharp knives, thus leaving the ends and sides without the fibrous covering, causing them to break badly. By the use of a novel bread-making machine this difficulty is said to be entirely obviated. This machine presses rather than cuts the dough apart, so that the fibre of the of the grain shall be preserved continuous. This object is accomplished by using in the cutting-machine thick knives which are rounded instead of sharp.

COMBINED MUFF AND LUNCH RECEPTACLE.

A novel lunch-receptacle and muff consists of two covered receptacles joined at their upper and lower extremities, leaving an intermediate padded space in which the hands are placed. The outside of this combined receptacle and muff, is highly finished and ornamented, so as to adapt it for street wear.

IMPROVED PIPE-JOINT COUPLING.

A late improvement consists of a pipe-joint for coupling pipes at any angle with each other. The coupling proper consists of two hemispherical shells fitting each other with an annular overlap joint. Each half shell has a pipe opening suitably screw-threaded, to receive the adjacent ends of the pipes. In order to keep the hemispherical shells in place and steam or water-tight, a central bolt is provided, passng through the shells, when it is desired to set the pipe-joint at a certain angle this bolt is loosened and the shells adjusted, after which the threaded bolt is again tightened.

SIGNALING BY ELECTRICITY.

This electric-signaling apparatus consists of a relay having a movable armature and retractor and a device for alternately breaking and closing the circuit thereof, combined with a local battery and circuit for operating registering apparatus, the terminals of which are controlled by the said relay-armature, whereby the condition of the local circuit is changed both at the movement of the relay-armature from and at its movement toward the poles of its magnet. A record is thus made both at the opening and closure of the main or relay circuit.

MACHINERY FOR WAXING PAPER.

This novel paper-waxing apparatus comprises a heated waxing-pan having a bar beneath its surface under which the paper is required to pass. The paper is then led to a pair of distributing, compressing, and calender rolls, located above or nearly over said pan, and an independent smoothing and cleaning device is located on the delivery side of said rollers.

DESULPHURIZING FURNACE.

A late and new process for desulphurizing ores consists of the following successive steps: first, drying the ore; second, subjecting the dried ore in a close chamber to thorough agitation; third, subjecting the ore to the action of heat; and, fourth, injecting hot air which has been dehydrated or deprived of its moisture. The air, before being admitted to the roasting-chamber, is dehydrated by being forced through a body of common salt.

ARTIFICIAL FILTRATION.

As illustrations of the process of filtration on a large scale, nothing better can be had, perhaps, than the filter-beds of the London Water Companies. They cover altogether close upon eighty-four acres of ground; and though they vary very greatly in their composition, the principle on which they are constructed is the same in all cases, and any one of them may be taken to exemplify the operation. In practice, all the companies requiring to filter their water do so by allowing it to stand in huge reservoirs, the bottoms of which are porous, and supported on brick arches, which at once form the base of the filter-beds, and the roof of a water-tank, from which the purified water is pumped up into the mains. The composition of the filter-beds varies with each company. The New River Company, the largest of them all, make their filters of two feet three inches of sand, underneath which are three feet of gravel, increasing in coarseness toward the bottom. Others are more elaborate. The Grand Junction Waterworks Company, for instance, make their filters by first depositing one foot of boulders, over which are nine inches of coarse gravel, then nine inches of fine gravel, six inches of hoggin, and two feet six inches of Harwich sand. The Lambeth and the Chelsea Companies, again, construct their beds of shells, as well as sand and gravel, though in different proportions, one having altogether eight feet of filter-

ing material, the other only seven feet. The object of all of them, however, is to make a porous bed through which the water will percolate slowly enough to insure efficient purification, but yet not so slowly as to make the process too tedious and expensive. As to what should be the rate at which the process may be carried on to be effective, is a point upon which authorities differ somewhat. Dr. Tidy considers that it should be as nearly as possible two gallons per square foot per hour; Colonel Frank Bolton, the Water Examiner under the Metropolitan Act of 1871, thinks it may be two and a half gallons. All agree, however, that it must not be too rapid.

Such filter-beds as those of the London companies are only modifications of the natural process of filtration up through beds of gravel and sand, from which the best of spring water flows. Authorities say that the sand not only acts as a strainer, but it performs the office of the rock in bringing every particle of the water into close contact with the air. The sand, they tell us, is but a vast collection of minute rocks; and every grain of sand is a particle of rock, incased in a film of air.

ANCIENT ROMAN COIN.

ST. LOUIS, April 27, 1882.

EDITOR KANSAS CITY REVIEW:—The following account of an ancient coin found in Illinois will without doubt be interesting to your readers. A few weeks since Dr. J. F. Snyder of Virginia, Cass Co., Illinios, wrote to me: "A rural friend in this county some time ago found on his farm a curious bronze coin or ornament, which he requested me to send to St. Louis or elsewhere for identification. Supposing that you are a numismatician as well as an archæologist, I will send it to you for your opinion."

Upon examination I identified it as a coin of Antiochus IV., surnamed Epiphanes, one of the kings of Syria, of the family of the Seleucidæ, who reigned from 175 B. C. to 164 B. C., and who is mentioned in the Bible (first book of Maccabees, chapter 1, verse 10) as a cruel persecutor of the Jews.

The coin bears on one side a finely executed head of the King, and on the obverse a sitting figure of Jupiter, bearing in his extended right hand a small figure of Victory and in his left a wand or sceptre, with an inscription in ancient Greek characters—BASILEOS, ANTIOCHOU, EPIPHANOUS, and another word partly defaced which I believed to be NIKEPHOROU; the translation of which is King Antiochus, Epiphanes (Illustrious), the Victorious. When found it was very much blackened and corroded from long exposure, but when cleaned it appeared in a fine state of preservation and but little worn.

Yours truly, F. F. HILDER.

EDITORIAL NOTES.

IN commencing the Sixth Volume of the REVIEW we are gratified to be able to state that it has continued to receive flattering commendations from all sources on the improvements made in its appearance within the past year and upon the popular character and good quality of the articles published. One of the most frequent comments of Eastern writers is surprise that the people of the West, where money making is supposed to be the chief object of life, should continue to support a magazine of its grade and purpose. They forget or overlook the fact that in the West liberality goes with money making and that many persons, who have little time to read the REVIEW, think it worthy of support and have it sent to distant friends as an evidence of the progress Kansas City is making as a centre of intelligence and knowledge as well as a commercial emporium. Numerous instances can be given where this kind of patronage has resulted to the advantage of the whole community at a very small cost to the individual. As has several times been stated, the publication of the REVIEW is a labor of love with its proprietor, who can only devote his evenings to the work and who has no expectation that it will ever be a source of profit, but who feels that it is an enterprise that should be fostered by all good citizens, not only for the good it may do in their own families, where it will pay for itself many times over every year,—but also because it helps to round out the city in those features which make it a desirable and attractive residence for the best classes of people.

ALL subscribers wishing back numbers of the REVIEW bound can have it done in handsome half morocco and cloth for $1.00 per volume by leaving them at this office.

THE Sixth Annual Meeting of the Kansas City Academy of Science will be held at the First Baptist Church, corner of 12th street and Baltimore Ave., on the last Tuesday of this month. The annual address will be delivered by Rev. Alex. Proctor. The exercises are open to the public.

THE Signal Service Bureau has published the Report of Sergeant J. P. Finley, on the Tornadoes of May 29 and 30, 1879, in Kansas and Missouri, and No. 4 of its Professional Papers. It is a comprehensive account, statistical, descriptive and theoretical, of the whole subject, which we shall take occasion to notice fully hereafter. Mr. Finley or some other officer of the Signal Corps will be sent out soon to investigate the tornadoes of last month, in which case we are expecting a synopsis of his report in advance.

PROF. WM. DAWSON, the Quaker shoemaker astronomer, of Spiceland, Indiana, says of the REVIEW in a recent letter, "I count it among the very choice part of my magazine literature, and hope to long receive it."

THE Twenty-First Annual Session of the Missouri State Teachers' Association will be held at Sweet Springs, (Brownsville) Saline County, Missouri, June 20, 21 and 22, 1882. Every friend of education is requested to encourage, by his presence, the objects of the Association.

THIS number of the REVIEW has been greatly delayed awaiting the receipt of the cuts for the completion of Mr. Wortman's article on the "Origin and Development of Existing Horses." When they did finally arrive mistakes were discovered necessitating the omission of the article and the substitution of another.

THE committee appointed by the National Academy of Science to investigate and report upon the sorghum-sugar industry, declares sorghum to be the best sugar producing plant next to the sugar cane of Louisiana, and that it has a continental spread of variableness and adaptation to various soils and climates of the United States.

ABOUT two years ago Mr. Leigh Smith, an English gentleman, sailed in his own yacht to penetrate the ice-barriers of the Polar Sea, since when he has not been heard of. The Geographical Society of England is going to send a search expedition out after him.

DE LESSEPS has recently celebrated his seventy-seventh birth day anniversary, at which time he announced that the Panama Canal would be completed by 1888, and that he expected to be at hand on the occasion of formally opening it.

PROF. TROWBRIDGE, of Glasgow, will give up teaching at the end of the present session and devote himself for a year to collecting specimens of natural history. He already has a very large collection which he wishes to dispose of to some western institution, but if he does not succeed in this it will go to some eastern museum. No better opportunity can be found for purchasing a first-class collection.

GENERAL HAZEN, Chief Signal Officer U. S. Army, promises to furnish the REVIEW with information, reports, etc., from the two Arctic stations, Lady Franklin Bay and Point Barrow, when received, probably in September or October.

THE number of distinguished scientists and literary men who have died during the present year is quite unusual. Draper, Darwin, Thomson, Longfellow and Emerson, were all men of world-wide reputations, though but one or two of them had reached much beyond sixty years of age. In our own State, Prof. J. T. Hodgen, of St. Louis, who died last week was a most skillful surgeon and able writer.

PROF. REID, of DesMoines, Iowa, in offering an article for publication says: "If I can in this way aid you in your arduous enterprise I wish to do it, for I know right well how difficult it is to keep up such a magazine as you are publishing, in this intensely business-ridden country."

PROF. C. A. YOUNG, the astronomer at Princeton College, took occasion in a recent pulpit lecture, to correct Maedler's theory of a central sun about which ours and all other solar systems are revolving as a common center.

THE Signal Service officers are collecting data for a comprehensive report upon the late flood in the Mississippi River which will be published as soon as practicable.

DR. R. J. BROWN'S report upon the Medicinal Plants of Kansas gives evidence of a great amount of careful and well directed personal labor which will be of especial importance to the State as the subject is still further developed.

PROF. G. C. BROADHEAD says of the wood being used in paving Wyandotte Street in this city: "It seems to be the kind used for telegraph poles, sometimes called white cedar. In Prof. Sargent's catalogue of 'North American Forest Trees,' he includes *Chamæcyparis Spheroidea:* wood reddish, light, soft, easily split and worked, and very durable. Still it seems too soft for my idea of paving-blocks. I don't like it. Use granite—Missouri Granite—and you will have a solid, good street."

HON. D. C. ALLEN, of Liberty, Mo., calls the attention of archæologists to certain ancient earthworks that he has observed in this portion of the State; the first in Cass County about half way between Strasburg and Gunn City and the other in DeKalb County, about three miles from Maysville on the road toward Cameron. We shall be glad to publish a full account of them in a future number.

THE U. S. Steamer Rodgers, which went to the Arctic regions last year in search of the Jeanette, was destroyed by fire near the coast of eastern Siberia January 1, 1882. The Steamer Corwin has been ordered to the relief of her officers and crew.

THE First Annual Exposition of the National Mining and Industrial Association will be held at Denver, commencing August 1st. It is intended to be the most complete and extensive exhibit of agricultural and and mineral products ever made in the west.

ITEMS FROM PERIODICALS.

THE April number of the *Nineteenth Century* contains an article on the subject of quieting the stormy waves of the ocean by the use of oil. Many cases are cited where this means has resulted successfully.

No. 31 of the well-known *Humboldt Library*, published by J. Fitzgerald & Co., No. 30 Lafayette Place, New York, consists of Part II of Richard Chevenix French's Study of Words. It is most curious, interesting and valuable. Price for the two parts, 120 pages, 30 cents.

AMONG the best articles in *Harper's Monthly* for May, aside from the excellent stories, are: Spanish Vistas, by Geo. P. Lathrop; Pennybacker's appreciative sketch of the Life and Work of David Rittenhouse, one of the earlier American Scientists, and F. Johnson's description of "The Upper Peninsula of Michigan."

THE *Atlantic Monthly* for May, 1882, presents the following table of contents: Two on a Tower, I.-IV., Thomas Hardy; Mad River, in the White Mountains, Henry Wadsworth Longfellow; The Arrival of Man in Europe, John Fiske; Aunty Lane, H. H.; Old Fort Chartres, Edward G. Mason; Doctor Zay, III.-V, Elizabeth Stewart Phelps; Sage or Poet, Edith M. Thomas; Progress in Agriculture by Education and Government Aid, II, Eugene W. Hilgard; The House of a Merchant Prince, VIII, IX, William Henry Bishop; Studies in the South, III; Evolution in Magic, Elizabeth Robins; The French Panic, J. Lawrence Laughlin; The Divine Right of Kings, Mary W. Plummer; Renan's Marcus Aurelius; The Contributors' Club; Books of the Month.

THE *Missouri Statesman*, the best weekly paper in Central Missouri, is making constant improvements in matter and manner and is entitled to full credit for its enterprise.

WE find in the *Popular Science Monthly*, for May, the following: Methods and Profit of Tree-Planting, by N. H. Egleston; Professor Goldwin Smith as a Critic, by Herbert Spencer; Monkeys, by Alfred Russell Wallace; The Development of the Senses, by Robert W. Lovett; The Stereoscope, I, by W. Le Conte Stevens, (Illustrated); Measurements of Men, by Francis Galton, F. R. S.; Liberty of Thought, by Rev. E. Woodward Brown; A Reply to Miss Hardaker on the Woman Question, by Nina Morais; The Genesis of the Sword, (illustrated); On the Diffusion of Odors, by R. C. Rutherford; Color-Blindness and Color-Perception, by Swan M. Burnett, M. D.; Stallo's "Concepts of Modern Physics," by W. D. Le Sueur; The Tree that Bears Quinine, by O. R. Bacheler, M. D.; Sketch of Sir John Lubbock, Bart., M. P. (with portrait): Entertaining Varieties: The Mountains of the Moon: The Chronicle of Hakim Ben Sheytan, etc.; Correspondence; Editor's Table: Science and Culture; Literary Notices; Popular Miscellany and Notes.

SUBSCRIBERS to the REVIEW can obtain all other magazines and books published in this country or England at from 15 to 20 per cent discount from the regular prices.

THE Kansas City REVIEW OF SCIENCE AND INDUSTRY is the most valuable periodical, devoted to science, published in the West, and indeed fills a place not occupied by any other magazine in the country.—*Clinton* (Wis.) *Herald.*

THE *North American Review* for May contains several valuable contributions by distinguished writers; notably Party Schisms and Future Problems, by Hon. Carl Schurtz; Days with Longfellow, by Samuel Ward; The Navy, by Lieut. Commander Gorringe; The Spent Bullet, by Gail Hamilton. That last named has probably attracted as much attention as any of them though by no means the most deserving. It is a "smart" specious, womanish essay, but as a just, critical review of President Garfield's case it is not entitled to any consideration. Its statements of fact are unfair and garbled; even the conclusions drawn from them, as stated, are illogical and unwarranted; the handling of the scientific questions involved is utterly unscientific; the discussion of the religious points is flippant and irreverent.

Two murderers, named respectively Baber and Ward, were hung in St. Louis a short time ago. Immediately after the drop the pulse of each was counted up to the moment of death, with the following result: Ward's pulse was forty for the first minute. The third minute it was fifty-seven. After that there was a gradual decline, and in five and a half minutes the pulse ceased to beat. For the first half minute Baber's pulse was normal, the next half it was thirty per minute. The second minute there was thirty-six strokes; third, sixty; fourth, seventy; fifth, seventy-six; sixth, fifty-eight; seventh, seventy; eighth, sixty-eight; ninth, forty-six; tenth, forty-eight. At the close of the eleventh minute his pulse ceased.

Office of the Review of Science and Industry.

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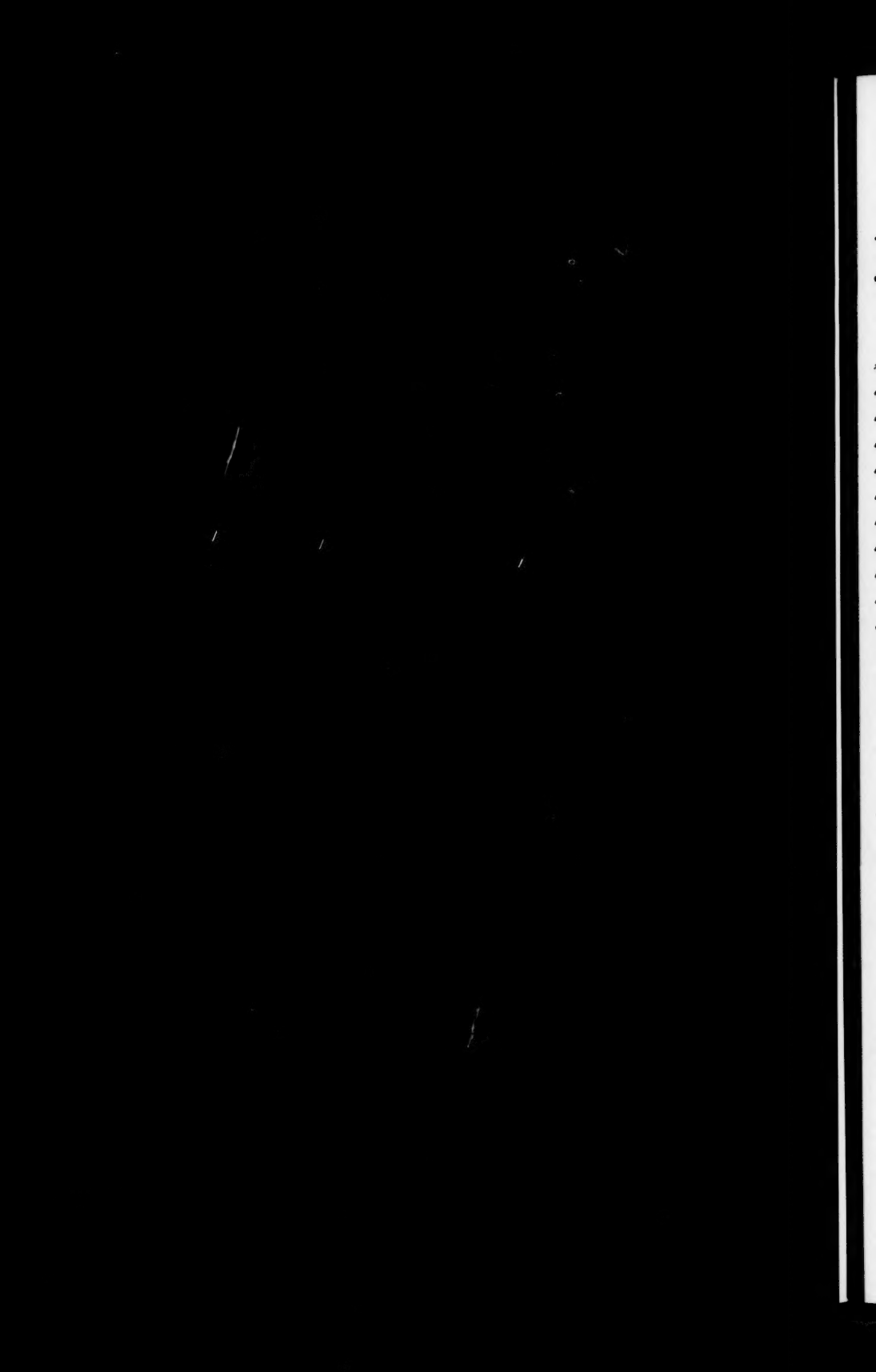

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